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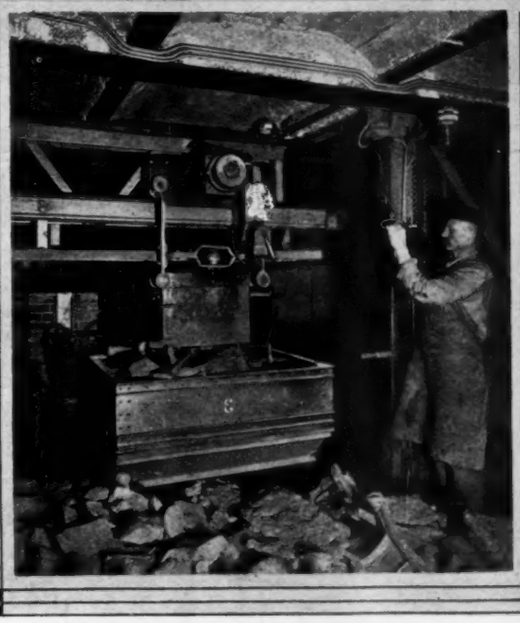
Telpher Systems Applied to Foundry Operations

How German Casting Plants Employ Overhead Trolley Systems for Handling Pig Iron, Coke, Sand, Etc.

By Dr. Alfred Gradenwitz

EUROPEAN foundries are developing to an unusually high state of perfection the use of telpher systems for building materials, and some specially interesting installations recently have been made in continental plants by Adolph Bleichert & Co., Leipzig-Gohlis, Germany. The telpher trolleys or trucks designed by this firm are now provided with electric hoists so that the load may be raised or lowered at will. Ordinary telphers used heretofore in European plants merely have been equipped with facilities for tilting the bucket. The electrically-operated hoisting telphers are controlled by a portable switch, which may be installed at any convenient point in the foundry yard. It is not necessary that each truck be accompanied by an operator; in fact, the hoists travel automatically behind one another at equal distances apart as determined by an electro-magnetic block system. Also, they may be so designed that their operation is entirely automatic. In this case they stop automatically at the unloading station, where the bucket may be lowered by closing the yard switch. The switch is again operated to lift the



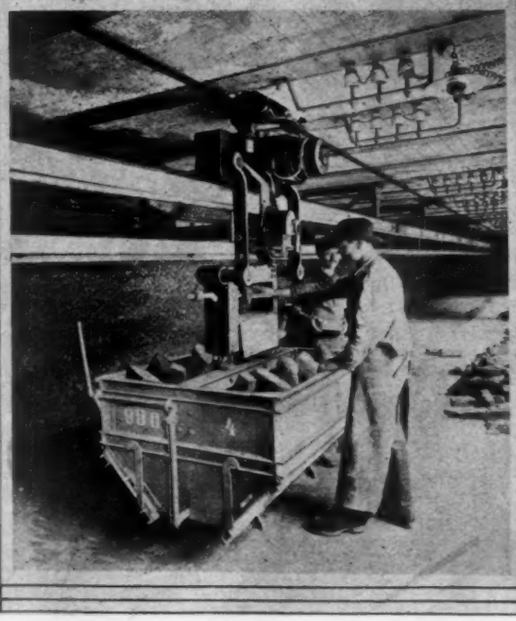
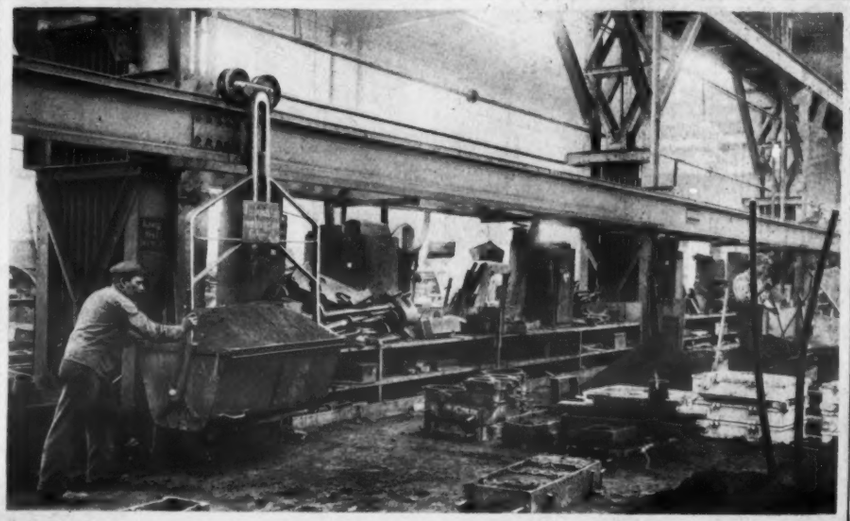
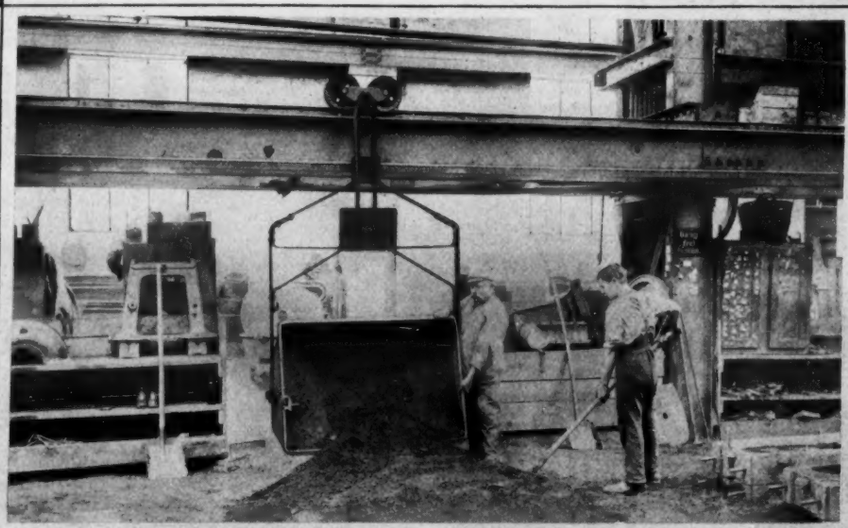


FIG. 1—LOADING PIG IRON INTO BUCKETS AND WEIGHING THE CHARGES

FIG. 2—TRUCK OF SCRAP ENTERING CHARGING FLOOR ELEVATOR

FIG. 3—WEIGHING ONE OF THE PIG IRON CHARGES





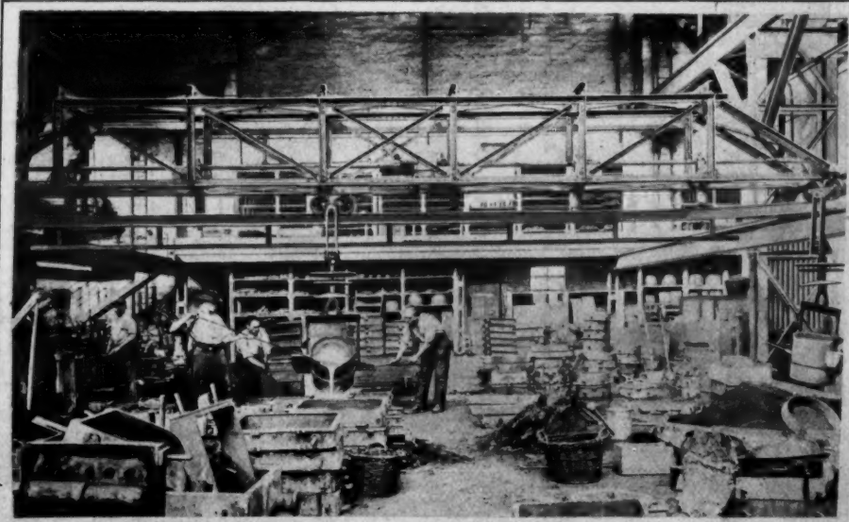


FIG. 4—DELIVERING SAND TO THE MOLDING FLOORS
FIG. 6—UNLOADING A BUCKET LOAD OF SAND ONTO THE MOLDING FLOOR

FIG. 5—FILLING BUCKETS WITH SAND FROM CHUTES
FIG. 7—POURING MOLDS FROM A LADLE SUSPENDED FROM A TRAVELING BRIDGE

new load and without any further attention on the part of the workman, the hoist winds up the bucket of its own accord. On arriving at the top, the bucket comes in contact with a limit switch which throws out the hoist motor and starts the traveling motor; the latter propels the telpher to its destination, where it is automatically tilted or unloaded and returned to the loading station. The design is such that any special requirements entailed by local conditions may be readily met. Any alteration of the regular sequence in the cycle of operations may be effected by means of the yard controller, which is placed in circuit with the hoist motor. This device permits the same bucket to be used in different parts of the yard at different times to handle coke, pig iron, limestone, etc. With automatic hoisting telphers it is possible to place the runway at a sufficient height to pass readily over yard obstructions and to bring the load on a level with the cupola charging floor.

A plant of this kind has been installed by Adolph Bleichert & Co. in the foundry of Les Fils de A. Piat & Cie, Soissons. Its principal features are shown in Fig. 10. The track is laid out in the form of a rectangle with rounded corners, one side of which passes over the railway tracks in the foundry yard and the other over the cupola charging floor. This telpher conveys pig iron from the yard and coke either from the yard or railway cars to the cupolas, and it is expected that eventually it will be extended so as to handle sand between the storage bins and mixing plant. The runway is of the usual I-beam construction supported by structural steel towers. The corner towers have four posts in order to properly resist lateral stresses. The runway is approximately 368 feet in length. It carries two telphers which are used to handle four buckets with a capacity of 10.6 cubic feet each for transferring iron and four buckets with a capacity of 53 cubic feet each for handling coke. A surplus of buckets is provided so that there will always be some loaded ones waiting to be exchanged in the yard for the returning empty ones. The telpher system is operated in conjunction with a narrow gage industrial railway which reaches all points in the yard, and the buckets are handled over the industrial tracks on small 4-wheel buggies. Turntables are located at the points where the buckets are transferred to the telpher hoists to facilitate handling the buggies. The buckets are weighed by a special machine before being hoisted. On the charging floor a switch is provided which actuates the mechanism for dumping the contents of the buckets into the cupolas. The coke is accumulated on the charging floor during the morning hours and the cupolas, as in American practice, are operated only in the afternoon when the telpher conveys iron exclusively. Two of the four cupolas are usually operated at one time. A more elaborate system has been installed in the foundry of A. Borsig, Berlin. At this plant there is also a rectangular track, Fig. 11, extending around the sides of the yard and leading in front of the cupola room. The construction of the runway is similar to that installed at the Soissons plant except that it is designed for carrying much heavier loads. The telphers operate on special round-headed rails, supported by I-beams. A yard crane or transfer bridge, which also carries a telpher rail, spans the main runway and permits the buckets to reach any

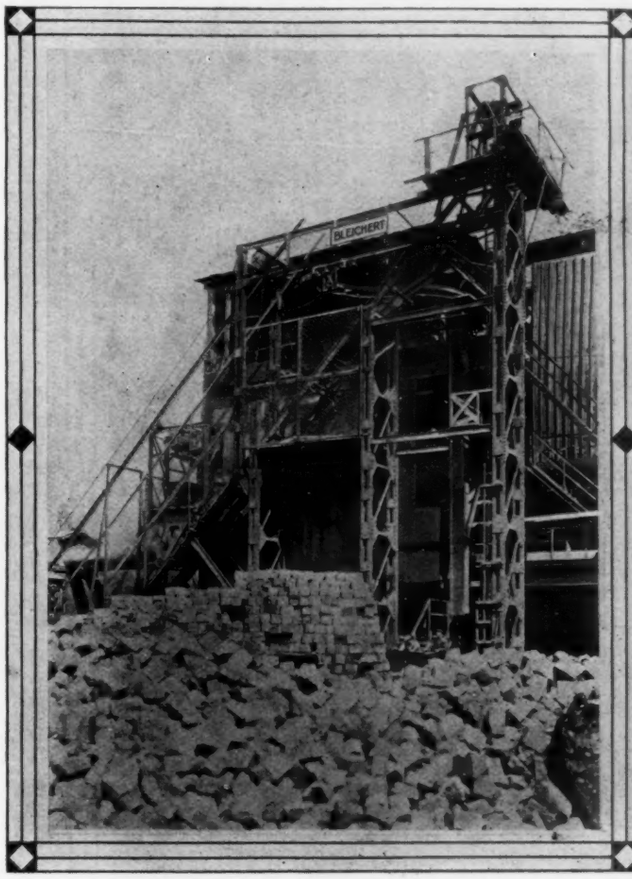


FIG. 8—INCLINED SKIP FOR ELEVATING TRUCKS TO CUPOLA CHARGING FLOOR

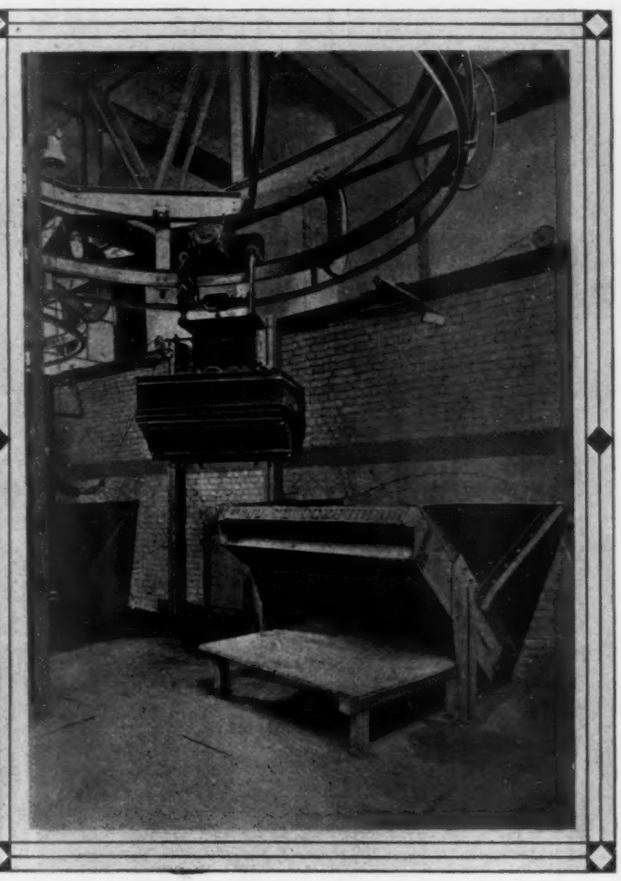


FIG. 9—SWITCH FROM ELEVATOR TO OVERHEAD TROLLEY SYSTEM

FIG. 10—TELPHER SYSTEM IN STORAGE YARD FOR CHARGING CUPOLAS
FIG. 12—TELPHER SYSTEM FOR HANDLING COKE AND PIG IRON

FIG. 11—ANOTHER STORAGE YARD TELPHER INSTALLATION
FIG. 13—ENTRANCE TO WEIGHING STATION OF YARD TELPHER SYSTEM

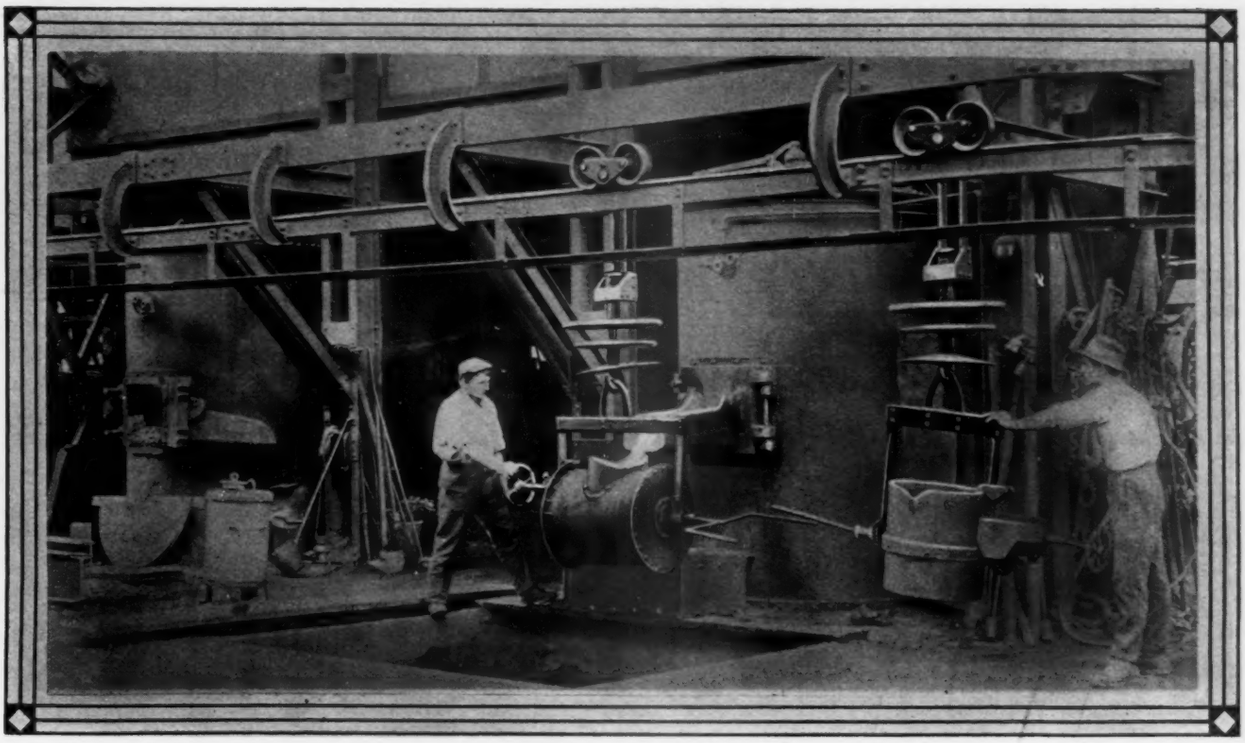


FIG. 14—TAPPING IRON INTO A CYLINDRICAL TROLLEY LADLE

point in the yard. Fig. 11 shows one of the trolleys on the transfer bridge lifting a bucket full of coke and the man actuating the controller may be seen at *A* in the same illustration. To the left another telpher is seen discharging its load of coke into a large, reinforced concrete bin. A bottom dump bucket is used in this case. The coke charged into the cupolas is drawn from the chute at the bottom of the bin. The transfer bridge divides the stationary runway into two separate loops, and this permits of buckets being conveyed from the yard to the cupolas, while at the same time materials arriving by rail on the other side of the bridge can be unloaded and distributed. As previously mentioned, drop bottom buckets are used in handling coke and side dumping buckets are employed for conveying iron.

The loading process is simple. The empty telpher coming from the cupolas is stopped over one of the industrial tracks which traverse the yard and the bucket is lowered onto a buggy standing on the track. The empty suspension tackle is then hoisted out of the way and the telpher proceeds. In the meantime another yard buggy carrying a loaded bucket has been pushed under the opposite side of the telpher runway where it can be picked up by the empty truck. Three electric telphers and two yard buggies are utilized in connection with five buckets with a capacity of 17.6 cubic feet each. As in the case of the French installation, illustrated in Fig. 10, a surplus of buckets is provided so that they can remain on the ground long enough for the charges to be properly made up and weighed.

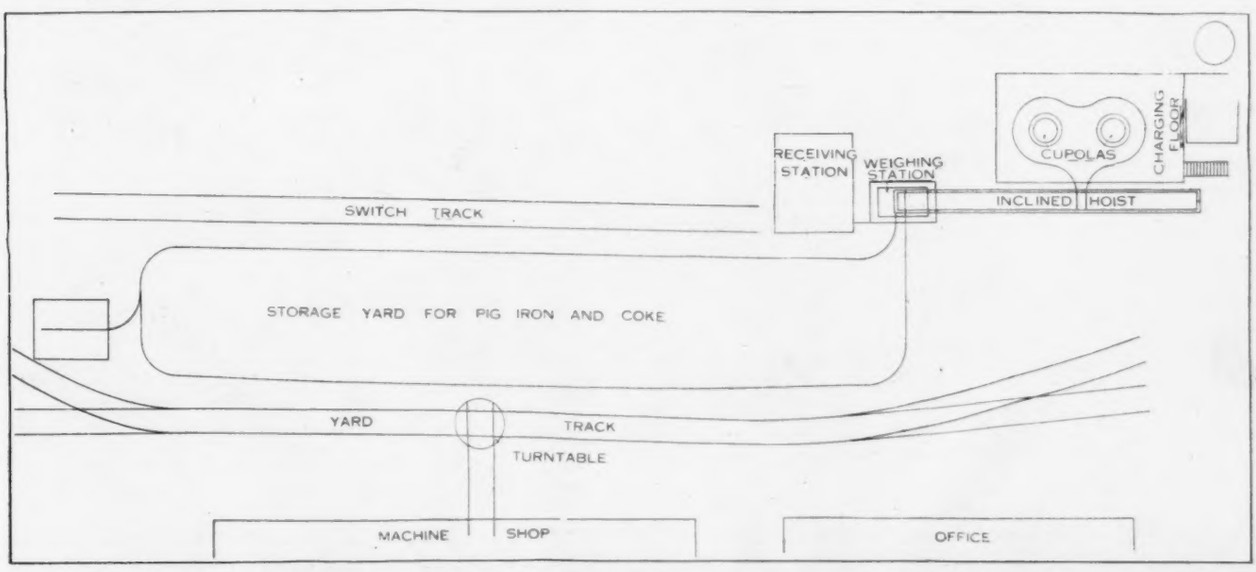


FIG. 15—PLAN OF TELPHER INSTALLATION AT THE FOUNDRY OF THE SOCIETE ANONYME DES FORGES

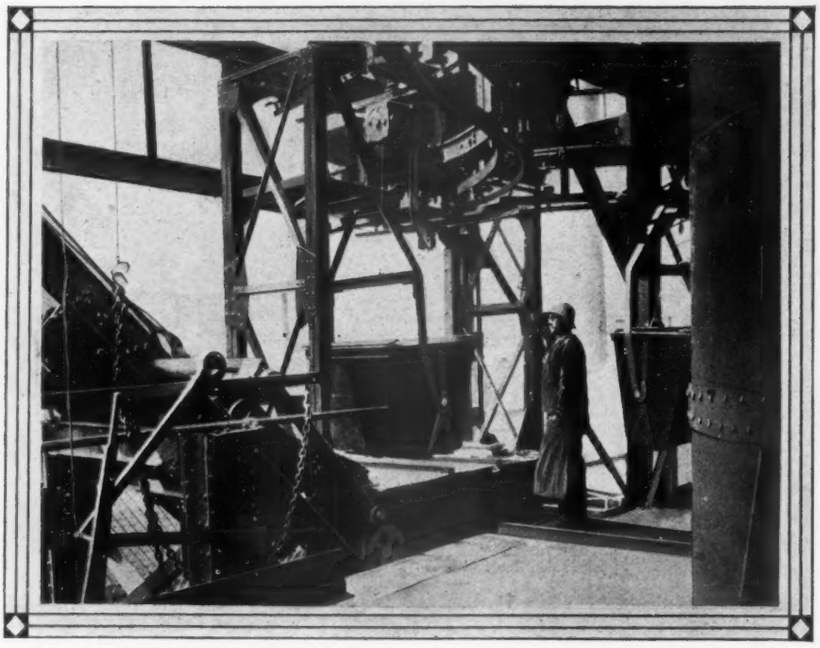


FIG. 16—SWITCH FROM THE INCLINED SKIP TO THE TROLLEY TRACKS ON THE CHARGING PLATFORM

An automatic weighing device is fitted to each of the yard buggies.

The contents of the buckets are discharged automatically into the cupolas by means of stops which release the latches on the bottom flaps. This device is clearly illustrated in Fig. 17. It will be noted that several steel bins are built in front of the cupolas into which the contents of the telpher buckets are dumped. From these bins the coke or iron drops into the cupolas through chutes closed by sliding doors. The doors are counterbalanced so that they may be easily operated. Fig. 1 shows a bucket in the yard being loaded with pig iron and weighed.

The cupolas at the Borsig foundry have a melting capacity of 16 tons per hour. The telpher runway is 533 feet in length; the lifting speed of the hoists is 67 feet per minute and the traveling speed 183 feet per minute. Each bucket carries 132 pounds of coke, 88 pounds of limestone and 1,320 pounds of pig iron.

A French Installation

Another interesting telpher system has been installed at the foundry of the Societe Anonyme des Forges, Vireux-Molhain, where a looped runway consisting of special double-headed rails supported on I-beams has been laid out. The track is only a few feet above the ground, permitting the buckets to be loaded by hand and obviating the use of hoist trolleys. The general arrangement of the system is shown in Figs. 12 and 15. Standard telpher trucks are used. The yard loop ends in a building containing a weighing machine, Fig. 13. From the latter the buckets enter a cage which travels on an inclined skipway shown in Fig. 8. The cage delivers the bucket to another system of telpher tracks installed on the charging floor. The design and operation of the skipway or inclined hoist is clearly shown in the illustration. The cage rests on the platform of a small 4-wheel car, which is hauled up and down the incline with a wire rope connected to an electric hoist. The telpher runway is 134 feet in total length and the difference in elevation between the charging floor tracks and the yard tracks is 36½ feet. The telphers have a speed of 183 feet per minute on the level track and the inclined cage hoist has a speed of 91½ feet per minute. Approximately 20 tons of iron and two tons of coke and limestone are handled every hour in separate buckets. The buckets are loaded either from the storage yard or direct from the railroad cars. In addition to the men engaged in loading the buckets in the yard and in checking operations in the weighing house at the foot of the inclined lift, only one man is required for working the system. He superintends the hoist operations and controls the charging of the various cupolas by adjusting the stops which dump the buckets. Unskilled labor, of course, is employed in the yard and the men in the weighing house need only be moderately skilled.

Serving the Cupolas

J. M. Voith, of Heidenheim, well known continental manufacturer of steam turbines, operates an extensive telpher system in connection with his foundry. The general arrangement of this plant is shown in Fig. 18. The cupolas are served by a Bleichert electric telpher line and the light gray iron foundry is also equipped with a hand-operated system. In addition, a special elevator for handling coke has been installed. The bins for storing coke, pig iron, etc., are sunk in the yard beside the railway tracks.

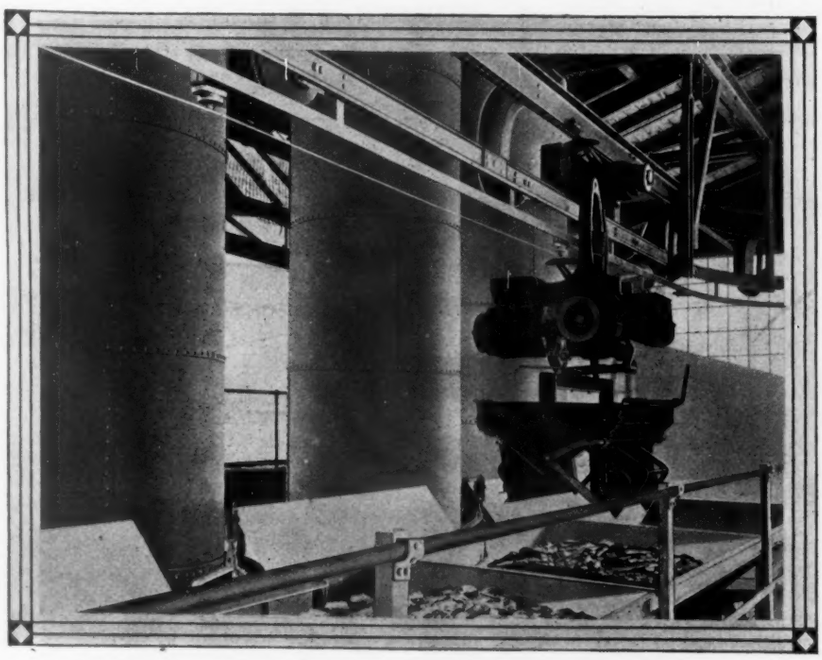


FIG. 17—CUPOLAS SERVED BY TELPHER SYSTEM SHOWING BUCKET DISCHARGING LOAD OF METAL

The telpher line is carried in a subway and after passing under the molding floor enters the cupola room where a single vertical elevator has been installed midway between the four furnaces. On the charging floor, the runway passes in a loop in front of all four cupolas, as shown in Fig. 18. Each bucket is provided with a special weighing device, Fig. 3, including a card printing apparatus which records the weight of the charges. The scale beams are specially calibrated to accommodate the individual charging practice of this plant. All the man at the weighing station has to do is to place the scale weight at the predetermined notch on the beam and load the bucket until the apparatus is in balance. The buckets are used to convey pig iron and coke simultaneously.

Charging the Furnaces

The trucks are delivered to the charging platform by the elevator, and are received by a man who dispatches them to the cupolas. Two of the four furnaces are usually operated at one time. The contents of the bucket are dumped into the proper charging hopper by unlatching the bottom doors.. A workman stationed in the subway at the bottom of the elevator checks the proper working of the apparatus at this point. The telpher runway is 640 feet in length and has a capacity of 14 tons of pig iron and 1.4 tons of coke and limestone per hour. The capacity of each bucket is 21.2 cubic feet. The traveling speed of the telphers is 183 feet per minute and the working height of the elevator is practically 40 feet. A single telpher is utilized for carrying sand from the storage bins to the molding floor.

The hand-operated trolley line in the light gray iron foundry is used for handling sand, finished castings and molten metal. It is 763 feet in length, and after passing alongside the cupolas enters the molding floor, where the loop is closed by a traveling bridge. The latter allows the trolley ladles to be taken directly over the molds to be poured. All of the pouring, therefore, is done from a bull ladle as illustrated in Fig. 7. The traveling bridge is operated by electricity, the motor being controlled from the floor. Two trolley ladles are utilized and one of them has a rather peculiar design, as shown in Fig. 14. It is cylindrical in form and is tilted by spur gear mechanism. The ladles each have a capacity of 1,320 pounds of molten iron and weigh 88 pounds when empty.

In addition to the trolley ladles, four telphers are used for transporting sand and castings. The sand-handling apparatus is illustrated in Figs. 4, 5 and 6. The runway extends in front of the sand chutes located behind the cupolas. The sand flows from the chutes into telpher buckets, as shown in Fig. 5. The buckets are dumped wherever the sand is needed on the floor, as illustrated in Fig. 6, and, if necessary, the trolley is run out on the traveling bridge.

It is claimed that electric telpher systems offer several advantages over other methods of cupola charging. Very little supervision is required to keep the system in operating condition. The charges can be made up in the yard where there is plenty of room, and once a system has been installed, its capacity may be increased by adding additional buckets and trolleys. As mentioned earlier in the article, loop lines, without difficulty, may be arranged for automatic operation. It is said that a small electric telpher outfit for charging cupolas in a Belgian foundry, which cost about $4,500, made it possible to dispense with the services of 15 men with aggregate annual wages of $5,625. It will be noted that the average pay of these workmen is only $375 per year, per man. In the United States, where labor costs about twice as much, the economies of the telpher system would be more apparent.

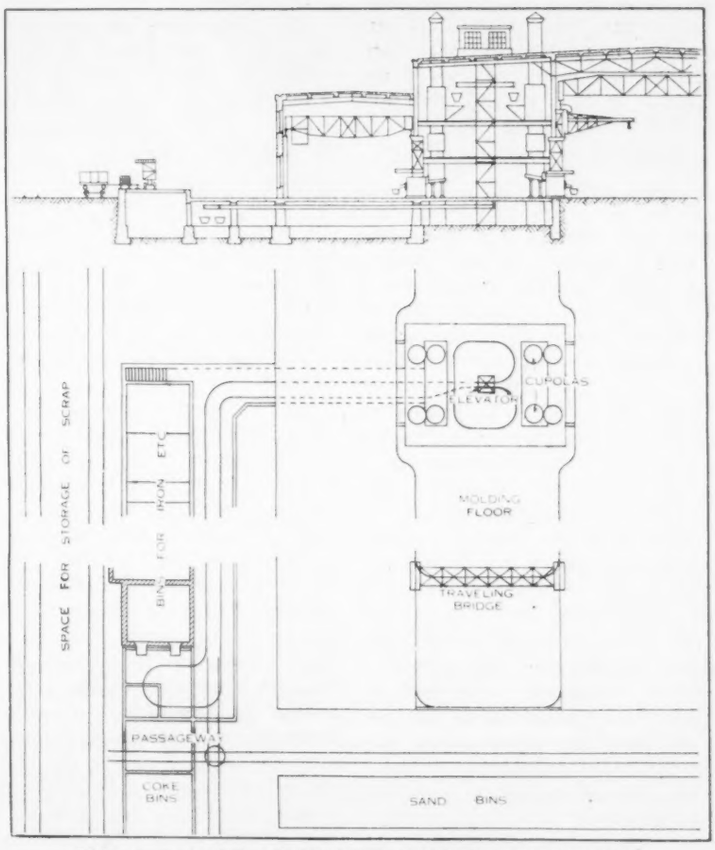


FIG. 18—LAYOUT OF TELPHER SYSTEM AT THE PLANT OF J. M. VOITH

New Pattern Plate Composition

A new composition for making pattern plates is being offered to the foundry trade by Murphy, Stedman & Co., Ltd., London, Eng. It is supplied in the form of a powder and a liquid, the latter being neither corrosive nor inflammable. When properly proportioned, the material sets in the course of a few hours and forms an extremely hard, stone-like compound with an excellent face. After the powder and the liquid have been mixed they are poured into a sand mold. The mold should be made of fine sand mixed with old machine oil and molasses and should be sprayed with a solution of paraffine in benzine in the proportion of one to nine. After the spray has evaporated, the mold should be powdered with talc. This imparts a coating which prevents the adhesion of the sand to the pattern plate. As the compound does not shrink in setting, it insures a perfect delineation of the pattern and the plate has a fine, hard surface. To obtain the best results, the plate should be varnished.

Precautions for Safeguarding Foundry Employes

Work of the National Founders' Association to Promote Safety in Foundry Operations, With Suggestions for Reducing Hazard

SAFEGUARDING the lives of foundry operatives is the problem that is being given serious consideration by the National Founders' Association and the special committee of this society, on safety and sanitation, has made a deep study of the subject, the results of which have been published in a series of bulletins.

"Caution is the Chief of All Safeguards" is the title of the first bulletin and it is pointed out that carelessness is the cause of more than nine-tenths of the several thousand accidents in foundries investigated during a period of seven month.

Preventable Accidents

Neglect of orders; foolish horseplay; lack of respect for the dangers of improperly handling molten metal or loads carried by cranes; the defective ladle; the worn shoe, the wrong shoe, and the turned-up, ragged or "holey" trousers, all of which invite foot-burns; the lack of protection to the eyes in certain classes of foundry work; the pig iron that tumbles from the carelessly arranged pile and crushes the hand or foot; the rusty nail that causes a serious wound and the neglect that causes it to fester; the spoonful of water in the spill-trough or chill that brings about an explosion; the unleveled floor and the obstructed aisle that forebodes disaster to someone, sometime; and even in some cases the flying spark and the splash of metal, all of these are different forms of carelessness in foundries that add to the list of preventable accidents.

Whether danger threatens openly or in ambush, a wholesome respect for danger decreases danger, while carelessness multiplies danger. *Most accidents happen when someone*—the laborer, mechanic, molder, foreman or manager—*does not care enough.* The greatest enemy is carelessness.

Whether caution is evidenced by the provision of mechanical appliances by the employer, or by his careful oversight as he directs his men, or whether it is shown in the care of the employe for his own safety or for that of his fellow-workmen—*this sense of caution must be recognized as the chief factor in accident prevention.*

It should be expected that the good sense of the workman would be quick to recognize that he should practice care in his work, for he must know that the serious results of a foolhardy action must fall upon his own head and that he and his family will be the chief sufferers. Yet the habit of taking chances has been handed down from generation to generation of workers, by whom accidents are looked upon too much as a matter of course; they must be taught that *most accidents are a matter of carelessness.*

The surest cure for the carelessness of men is an education in caution, which has been described as a wise mixture of example, counsel and discipline. If, however, workmen are to be safeguarded against themselves and protected against their own indifference to danger, the employer must do it, or it will not be done. He is the main-spring of action in safety affairs as in all other matters that pertain to his plant; his intelligent supervision and initiative count most in the education of his men in proper caution.

In one plant where accidents have been considerably reduced, one of the foremen said: "The manager counts it gross neglect to have disorder or carelessness here, and considers the occurrence of a preventable accident a disgrace to the foreman." Through the foreman this conviction of the manager has been circulated throughout this entire large plant, with such good effect that all classes of workmen have been taught to feel the reproach that is attached to anyone who, through carelessness, endangers the safety of anyone in the shop, or who allows, without at least a protest, wrong conditions to remain which may contribute to the injury of any workman. This manager's conviction was thus made the conviction of the foremen, and through them it became the conviction of all of the employes; a good practical lesson in caution.

The Value of Example

Education in caution may be carried still farther by force of example of those in charge of foundry workers. If the superintendent would apply his wit and energy to remedy every hazardous condition which may be found to exist in his plant, whether it is a mechanical defect or an unsafe method of work; and if the foremen or subforemen would show appreciation of the safest ways of handling or placing material; if they would wear proper shoes themselves, and use goggles where goggles are needed; if they would see to it that no menacing obstruction is left in the path of workmen, especially when molten metals are being poured; such examples would show the sincerity of the executives, and excite in others a keener regard for such dangers and a desire to use all reasonable accident preventive measures. By these examples, by careful explanation, by strict orders and discipline, the foremen can preach most effectively, and finally the men will appreciate that, while nothing worth while is accomplished in industrial work without a certain exposure to danger, it would be rank foolishness to walk into the mouth of it. As a general provides his soldiers with rifles that will not explode prematurely and drills them in their proper use, so it is the moral and legal responsibility of the employer to provide work shops and appliances that are suitable and reasonably safe, and train the men how to use them.

The Injured Workman

It also must be made clear that that workman is not an object of sympathy who suffers injury through neglect to use the safeguards provided, or who meets with accident through carelessness or defiance of orders; he must be treated with the severity which he deserves. He has not even used selfish common sense, which would have prevented such an accident; for he must have known that it was *his body* that might be maimed, and *his family* that might suffer loss of a supporter through his carelessness. He is in the class of employes who must be weeded out, for he is a menace to himself and to the workmen with whom he is employed.

Accidents were reduced 65 per cent in a certain steel mill by studying the accidents and conditions, installing safety devices, and by securing the co-operation of the employes. In other lines of industry where sincere efforts were put forth to minimize the accident loss, a reduction of 50 per cent in some plants, and even considerably more in others, has been accomplished.

Aside from the humane consideration involved in the effort for the safety of employes, there is also the economic phase of the problem, that should appeal to every employer of men. Those em-

ployers who have followed safety matters most closely have testified that it is not only *possible* to prevent many accidents, but that it *pays*. It pays in the satisfaction realized in providing safer employment, thus increasing the sum of human happiness; it pays in self-respect and in the greater loyalty of the men who have thus been protected while earning a livelihood for their families; and it pays in reduced financial liability of the employer to those employes who have been injured or disabled in his service.

The dangers incident to foundry work are, for the most part, well known, and the remedies are as obvious. The great *danger of the danger*, however, is indifference to it, and neglect of well known remedial measures.

Caution Signs

The second bulletin issued by the safety committee of the National Founders' Association is devoted to "Caution Signs", which are compared to special watchmen delegated to stand at dangerous places to say to each person who may approach: "Be careful—there is danger here."

The bulletin states that caution signs should be used in any place where unusual danger exists, or where usual danger is not apparent. Yet often where usual danger is apparent, as in oiling machines when in motion, caution signs should be used as a constantly repeated warning to the hardened employe, who, on account of long contact with such danger, may become indifferent to it.

When workmen are repairing cranes or working on any other overhead structure, a caution sign stationed underneath quietly, but effectually warns those below of the danger of falling tools or materials.

Where excavations have been made and men are liable to stumble into them; where a temporary entrance leads to a track on which moving industrial cars are apt to surprise and endanger the unwary workman; where a rapidly moving belt or machine is located inside of a door, into which an employe may rush headlong; where men run the risk of bumping their heads upon a low rafter in the cupola room or upon a dangerous projection in the sand shed, which may not be apparent; or where there are electrical hazards; for all of these and similar conditions, caution signs may be utilized to assist in safeguarding workmen.

While such unsafe conditions are being remedied, the use of caution signs affords considerable protection. In the interim a suitable guard for the belt or machine can be provided, the cupola roof raised or the floor lowered, the dangerous projection in the sand shed eliminated, or such other safety measures installed as the exigencies of the case may require and permit.

When, however, proper remedies have been applied, the caution signs should immediately be removed. *Caution signs talk loudest if displayed only when real danger is imminent;* they are most conspicuously on the job if they are conspicuously absent when there is no job for them. Therefore, they should be kept out of sight when not in active use, and not merely shoved aside.

Yet the caution sign must be considered only in the light of a temporary measure; the elimination of the dangerous condition must be the goal. A "Look Out for the Locomotive" caution sign is good; the abolished grade crossing is best.

Where caution signs were used in connection with the indoor activities of men or in outdoor places where men worked more or less permanently, single words at first, simple phrases later, and finally extended notices were employed to express messages of warning.

As the character of the working force in American industries changed through the infusion of large numbers of foreign laborers, many of whom were ignorant of the English language, the notices of warning were translated into foreign tongues and so inscribed on caution signs. Where a number of languages were used, the signs either became too large for convenience or the inscriptions too small to be easily read.

Pictorial Signs

Man's ingenuity, therefore, turned to pictorial designs as a universal means of talking to people of all tongues. So the picture of a skull and crossbones found large acceptance as a message of caution; and the fist of Thor gripping a thunderbolt became a much favored design as a warning of electrical hazards.

Pictorial designs, however, are apt to attract attention to the design itself rather than to its purpose. The first impression made by a pictorial sign is "There is a *picture* here; what does it mean?" While the important requirement of a caution sign is to say simply and forcefully: *"Be careful—there is DANGER here."*

Of late the use of a red disc with no words or pictures whatever upon it, has been advanced as a simple and yet expressive caution sign. This has no doubt followed the accepted practice of railroads, and its only objection may spring from the fact that, as it is a universally accepted caution sign in railroad operation, there is fear that its general application to all dangers may weaken the strong effect it now holds in connection with railroad dangers. In order that familiarity may not breed contempt, the extraordinary hazard in railroad operation should have all the protection which a distinctive railroad caution sign can provide.

With these facts in mind, the N. F. A. committee decided to recommend for general purposes a caution sign, on which the word *danger* is displayed in plain white capital letters, on a red background.

The word *danger* is forceful and conveys the idea of caution and danger more clearly than any other word in the English language; it is, therefore, eminently effective in warning men who can read English. It was selected, however, not merely as a suitable word, but primarily as a *word picture* or as a *symbol* of danger, which, when once explained, will be recognized as such by all workmen, *no matter what language they read.* It is a short word which fastens itself readily upon the minds of men; to the foreign speaking workmen it becomes a symbol which stands for the proper word in their own language.

Danger Sign

Plain capital letters should always be used, for the word Danger when expressed **Danger** does not convey the same picture as the symbol **DANGER.** There should be no embellishment whatever upon the sign. Unhampered by fanciful or startling designs of any sort, this word stands out most clearly as the symbol of danger.

Where a special purpose requires it, other words may be added or substituted to point out the specific nature and locality of the hazard.

The chief consideration in choosing red for the background and white for the letters was to effect a strong contrast between the two. At the same time it was recognized that red had been the universal danger color for many generations. Oftentimes, however, white letters on blue background, or black or blue letters on white background, are used.

Caution signs should be sufficiently large to be readily distinguished by approaching persons before they reach the danger zone. Ordinarily, letters 3 inches high on ample background will meet the requirements, while smaller signs of corresponding proportions will be satisfactory when they need to be noticed only at close range.

In selecting the material of which caution signs are to be made, due regard must be given to the question of permanency, and their ability to withstand exposure to high temperatures if used around furnaces, or to endure extreme weather conditions when used outdoors. Enameled or

painted metal signs are, of course, most durable and are suitable for nearly every purpose. Less expensive signs may be printed, painted or stenciled upon paper, muslin, oilcloth, hard fiber, tin or wood. Paper or muslin signs will have longer life if attached to backs made of wood, hard fiber or tin, and then varnished. Signs used in proximity to electrical apparatus, if made of metal, should always be mounted on wooden or hard fiber backs, at least 2 inches larger each way than the metal signs; but it is safer to make them entirely of wood or hard fiber.

Caution signs may be either of the wall type or of the floor type.

The wall type signs are intended to be fastened to walls, posts, machines or similar supports, or to be suspended in midair.

For other specific purposes caution signs of similar proportions may be inscribed with other appropriate phrases; the wording, however, should always be concise and clear — the shorter the phrase, the more forceful becomes the message.

It is quite common to attach caution signs to machine tools, to warn the operators or others not to remove safeguards from the machine, or not to clean, oil or repair the machine while it is in motion.

Floor Type Signs

An all-metal, floor type caution sign is recommended for outdoor use. The sign should have a tripod support with pointed prongs to make it suitable for use upon uneven as well as level floors, whether made of cement, brick, wood or dirt.

Since this sign is used mostly in open places, the warning notice on it should be visible from both sides; and inasmuch as it is employed only for frequent temporary use, it should be so constructed that when not in use, the words of warning may readily be put out of sight. The sign, therefore, is provided with two caution plates hinged to the tripod stand and fitted with a latch at the top.

The sign should be of such height that the symbol *danger*, in 3-inch letters on a red background, 18 inches long, would stand about 4 feet from the ground, which would place the warning in a convenient position to attract the attention of approaching workmen. If the sign is made much higher, it would become top-heavy, unless provided with very long supporting prongs.

When this sign is intended to warn of the danger of material falling from overhead, it may be found useful to paint an arrow on the sign, pointing to the source of danger; similarly an horizontal arrow pointing to the left or to the right will serve specific purposes.

In nearly every plant an investigation will bring to light some locations where hazardous conditions exist and where caution signs will greatly assist in protecting the workmen.

Yet, even though the premises should be so well protected that no immediate need for caution signs may be apparent, it must be remembered that emergencies may arise suddenly, and caution signs should then be on hand. It is advisable, therefore, to keep a supply of these signs in a convenient place for instant service.

Foundry Floors

Another bulletin, devoted to "Foundry Floors", states that the foundry floor is the foundryman's principal field of action and because experience has proven that many accidents are due to improper footways upon such floors, it is advisable to study the character of these accidents and to consider what may be done to prevent them.

The most common and perhaps the most serious form of accident which occurs in foundries is that of burns by molten metal. These accidents usually are caused by "spills" as the workman carries his ladle over irregular places, when he imparts an excessive billowy motion to the metal and causes it to slop over the ladle's sides. Such accidents also happen when the workman, full ladle in hand, collides with or stumbles over articles lying upon the floor, or when he must thread an awkward passage through unsuitable or narrow aisles, or climb over molds, flasks or other paraphernalia where no aisles are provided; or when the restricted condition of the aisle causes workmen to jostle each other in passing. Other forms of accidents are caused by improper floors, as when workmen, who must retreat quickly to avoid an impending danger, are hampered by lack of a clear avenue of escape. Flasks or flask plates, castings or molds, when stacked on unlevel floors are liable to topple over and cause injury.

While, without doubt, carelessness of men is the cause of many molten-metal accidents, yet it has been shown by experience and observation, that where foundry floors are reasonably level, and clear aisles are carefully maintained, the number of injuries by accident has been materially reduced. Furthermore, the discipline which is practiced daily to keep the floors in good condition impresses upon the workmen the importance of "playing safe", and especially during the pouring period; thus *the orderly floor becomes a continuous object lesson in caution, and safe habits of handling molten metal are developed.*

It is generally recognized that it is important not only to establish proper floor levels and clear aisles, but also to provide some method, more or less automatic in its working, which will guide and prompt the men to maintain these from day to day. A study of conditions in many foundries reveals various ways by which these results are accomplished.

Where the work is standard and the floors not frequently broken up, a paved aisle is sometimes used to give the aisle lines and the floor levels; sometimes an industrial track is utilized as the level, and the aisle lines are set at a given distance from it. In one foundry, hooks are permanently located in the floor at the ends of the aisles, and a twine line is stretched from these hooks each morning to guide the workmen in dressing down or building up the floors and in placing their molds. There is, however, some danger of tripping over the twine during the half hour or so when it is in place.

A very good plan, and one that seems applicable to most floors, was observed in a jobbing foundry doing miscellaneous work requiring frequent changing of floors. Here 4 x 4-inch square wooden stakes were driven at close intervals to show the aisle lines. The tops of the stakes indicate the floor level which is to be maintained; the stakes are easily removed and replaced when necessary. Workmen are not apt to stumble over them, for they are usually covered with a small amount of sand; and iron does not spatter if it strikes the stakes. Individual floors are often apportioned by these stakes, which silently settle disputes between the molders if one encroaches upon the other's space, or if he infringes upon the aisle room.

Side Aisles

While the first emphasis should be placed upon clear main aisles, it must not be overlooked that the condition of side aisles and individual floors is equally important. They must be so arranged as to give the pourer access to the molds without climbing over other molds, and he should have ample room to walk and to stand safely when pouring, and to avoid risk of collision with other workmen or with flasks, partitions or posts.

Small tools and other articles should be picked up before the heat is run, for more serious accidents are caused by tripping over small obstructions like flask clamps, wedges or hammers, than over larger and more apparent objects. The ladle shank laid in the passage for "just a minute" or the skimmer thrown

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

FORMULAS FOR FINDING THE WEIGHTS OF CASTINGS

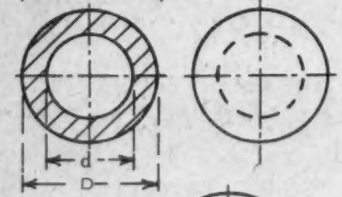
By W. L. Tryon

To find the weight of a solid triangular casting, multiply the length by the width by the thickness by the constant, *k*, corresponding to the weight per cubic inch of material used. (See table below.)

$$W=LBTk$$

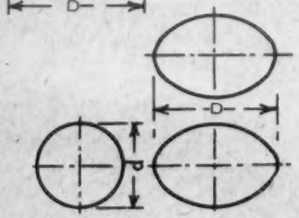
To find the weight of a solid sphere, multiply the diameter cubed by the constant, *m*, corresponding to the weight per cubic inch.

$$W=D^3m$$



To find the weight of a hollow sphere, multiply the difference between the cubes of the outside and inside diameters by the constant, *m*, corresponding to the weight per cubic inch.

$$W=(D^3-d^3)m$$



To find the weight of an ellipsoid, multiply the square of the revolving axis by the fixed axis by the constant, *m*, corresponding to the weight per cubic inch.

$$W=Dd^2\times m$$

Wt. per cu. in.	k.	m.	Wt. per cu. in.	k.	m.	Wt. per cu. in.	k.	m.	Wt. per cu. in.	k.	m.
.096	.048	.0503	.210	.105	.1100	.330	.165	.1728	.450	.225	.2356
.100	.050	.0524	.220	.110	.1152	.340	.170	.1780	.460	.230	.2408
.110	.055	.0576	.230	.115	.1204	.350	.175	.1832	.470	.235	.2460
.120	.060	.0628	.240	.120	.1257	.360	.180	.1885	.480	.240	.2513
.130	.065	.0680	.250	.125	.1309	.370	.185	.1937	.490	.245	.2565
.140	.070	.0732	.260	.130	.1361	.380	.190	.1989	.500	.250	.2617
.150	.075	.0785	.270	.135	.1414	.390	.195	.2042	.510	.255	.2670
.160	.080	.0838	.280	.140	.1466	.400	.200	.2094	.520	.260	.2722
.170	.085	.0881	.290	.145	.1518	.410	.205	.2146	.530	.265	.2774
.180	.090	.0943	.300	.150	.1571	.420	.210	.2199	.540	.270	.2827
.190	.095	.0995	.310	.155	.1623	.430	.215	.2251	.550	.275	.2879
.200	.100	.1047	.320	.160	.1675	.440	.220	.2303	.560	.280	.2931

INTERPOLATION TABLE

Ad'l wt.	Ad'l k.	Ad'l m.	Ad'l wt.	Ad'l k.	Ad'l m.	Ad'l wt.	Ad'l k.	Ad'l m.
.001	.0005	.0005	.004	.0020	.0021	.007	.0035	.0037
.002	.0010	.0010	.005	.0025	.0026	.008	.0040	.0042
.003	.0015	.0016	.006	.0030	.0031	.009	.0045	.0049

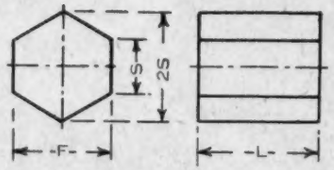
All dimensions in inches and weights in pounds.

For methods of interpolation see Data Sheet No. 129.

DATA SHEET No. 155, THE FOUNDRY, FEBRUARY, 1914.

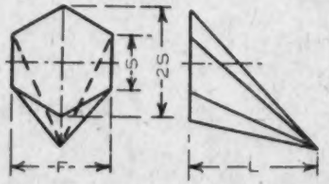
FORMULAS FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon



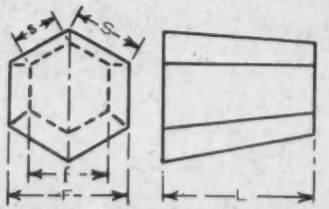
To find the weight of a hexagonal casting, multiply the square of the side by the length by the constant, *k*, corresponding to the weight per cubic inch, or multiply the square of the distance across the flats by the length by the value of *M*. (See table below.)

$$W=S^2LK \text{ or } W=F^2LM$$



To find the weight of a pyramid with a hexagonal base, multiply the square of the side by the length by the value of *M*, or multiply the square of the distance across flats by the length by the value of *C*.

$$W=S^2LM \text{ or } W=F^2LC$$



To find the weight of a frustrum of a hexagonal pyramid, multiply the sum of the side of the large base squared, the side of small base squared and the product of the two sides by the length by *M*, or multiply the sum of the distance across the flats of the large base squared, the distance across the flats of the small base squared and the product of the two sides by the length by *C*.

$$W=(S^2+s^2+Ss)LM \text{ or } W=(F^2+f^2+Ff)LC$$

Wt. per cu. in.	K.	M.	C.	Wt. per cu. in.	K.	M.	C.	Wt. per cu. in.	K.	M.	C.
.096	.2494	.0831	.0277	.250	.6495	.2165	.0722	.410	1.0652	.3551	.1184
.100	.2598	.0866	.0289	.260	.6755	.2252	.0751	.420	1.0912	.3637	.1212
.110	.2858	.0953	.0318	.270	.7015	.2338	.0779	.430	1.1172	.3724	.1241
.120	.3118	.1039	.0346	.280	.7275	.2425	.0808	.440	1.1432	.3811	.1270
.130	.3378	.1126	.0375	.290	.7534	.2512	.0837	.450	1.1691	.3897	.1299
.140	.3637	.1212	.0404	.300	.7794	.2598	.0866	.460	1.1951	.3984	.1328
.150	.3897	.1299	.0433	.310	.8054	.2685	.0895	.470	1.2211	.4070	.1357
.160	.4157	.1386	.0462	.320	.8314	.2771	.0924	.480	1.2471	.4157	.1386
.170	.4417	.1472	.0491	.330	.8574	.2858	.0953	.490	1.2731	.4244	.1415
.180	.4677	.1559	.0520	.340	.8833	.2944	.0981	.500	1.2990	.4330	.1443
.190	.4936	.1645	.0548	.350	.9093	.3031	.1010	.510	1.3250	.4417	.1472
.200	.5196	.1732	.0577	.360	.9353	.3118	.1039	.520	1.3510	.4503	.1501
.210	.5456	.1819	.0606	.370	.9613	.3204	.1068	.530	1.3770	.4590	.1530
.220	.5716	.1905	.0635	.380	.9873	.3291	.1097	.540	1.4030	.4677	.1559
.230	.5976	.1992	.0664	.390	1.0133	.3378	.1126	.550	1.4289	.4763	.1588
.240	.6235	.2079	.0693	.400	1.0392	.3464	.1155	.560	1.4549	.4850	.1617

INTERPOLATION TABLE

Ad'l wt.	Ad'l K.	Ad'l M.	Ad'l C.	Ad'l wt.	Ad'l K.	Ad'l M.	Ad'l C.	Ad'l wt.	Ad'l K.	Ad'l M.	Ad'l C.
.001	.0026	.0009	.0003	.004	.0104	.0035	.0012	.007	.0181	.0060	.0020
.002	.0052	.0017	.0006	.005	.0130	.0043	.0014	.008	.0207	.0069	.0023
.003	.0078	.0026	.0009	.006	.0155	.0052	.0017	.009	.0233	.0078	.0026

For method of interpolation see Data Sheet No. 129.
All dimensions in inches and weights in pounds.

DATA SHEET No. 156, THE FOUNDRY, FEBRUARY, 1914.

down hastily, sometimes causes the next passing workman to trip or stumble with disastrous results. To overcome this, the foreman or an assistant should make it a point to see that each molder clears his floor each day before pouring begins; a standard place for the skimmer should be assigned, also a place for temporarily resting the ladle, but *not in the aisles.* Perseverance and discipline in this regard will develop a daily habit of keeping the floor clear.

Sometimes it is expedient for molders to shake-out molds and break-off sprues while castings are yet hot, and before others have finished pouring. A strict rule should be observed to prevent workmen from throwing such castings, sprues or molds into aisles, particularly while others are carrying molten metal through them.

Spill Troughs

Spill troughs or pig molds have been observed in some aisles; convenience usually dictates this position. Workmen are apt to trip over them and sometimes stumble into them when they contain hot metal. In some foundries they are located in a safe place under the cupola platform, or in the rear of each molder's floor, or in a position usually occupied by one of the molds. The need for clear aisles, with no obstruction whatever, is so evident that a special effort to keep the spill troughs away from them is amply warranted.

The foundry which is cramped for floor space has most difficulty in providing proper aisles; at the same time its crowded condition constitutes an added risk which demands extra precaution.

One foundry has been observed which resolutely faced such a condition and solved this vexing problem in a very satisfactory way. The manager took the view that each foot of space on his crowded molding floor was more valuable for producing castings than for anything else. The floors were rearranged, but with no allotment of space for any purpose except that actually required for molding and pouring operations. Places were provided upon posts, partitions or shelves for the storage of all tools. There was a hook for every shovel or ladle shank; double shanks were suspended from light chains alongside of the cupola. Each chain sling had its proper position, but not upon the floor; ladles, when not in use, were stored in a separate room, where they were relined and dried. Flasks, patterns or other accessories used yesterday, but not wanted today, were immediately carried to the flask storage yard or to the pattern vault; regular positions were assigned for each molder's stock of flasks, flask boards and weights, as many as he needed for the day's work, but not more; barrows, trucks, or sand boxes were banished from the foundry except when in actual use. Neat, strong shelves were provided about the walls upon which to store extras which might be required upon a moment's notice.

In a similar plant, where space is exceedingly valuable, a structural steel platform was built at one end of the shop, on which to store the large bull ladles and the heavy anchor blocks, which otherwise would crowd the floor; a storage rack for cores was constructed under this platform.

The results gained in these crowded foundries, combining good production with the safety of the men, are so satisfactory that similar methods suggest themselves for other plants which may not be crowded. The presence of unnecessary appliances in any foundry causes a waste of space, often obstructs the light and impedes free movement. A good rule is to keep in a convenient place in the foundry all accessories which are needed in it, but to remove them to a convenient place outside of the foundry as soon as there is no immediate need for them. The adoption of this principle will asist in maintenance of proper floors, with clear aisles.

Order in the foundry makes available the greatest floor area for actual production of castings and thus allows the employment of more men within the same space. It attracts a better class of workmen, who appreciate orderly and safe conditions; they are usually the more efficient workmen.

The orderly foundry is the safest foundry; it is also the most productive.

Foundry Yards

"The Safety Aspect of Foundry Yards" is the subject of another bulletin, in which the foundry yard is characterized as the gateway of the foundry system, through which the supplies and raw materials enter the shop.

The yard, moreover, is used for the storage of materials awaiting the call of the foundry; in many plants the foundry yard also is the storage depot for flasks and other equipment, and sometimes also for castings ready for distribution.

Space in the foundry yards is not nearly so expensive as space in the foundry buildings and the overhead charges are comparatively small. It is good economy, therefore, to use the foundry as largely as practicable for manufacturing purposes only and the foundry yard for storage.

The foundry yard should be an orderly place, because order makes for safety. Therefore, every argument in favor of order is an argument in favor of the safety of employes, and every activity toward orderly conditions is a move in the direction of safety.

The orderly yard, because it is more commodious and accessible than the disorderly one, offers greater inducement to move back and forth, as needed, those parts of the foundry equipment which would otherwise litter and crowd the foundry buildings. When, therefore, the entire area of the yard is made conveniently available for the storage of materials and equipment, the yard greatly relieves the otherwise congested condition of the foundry interior, adds to the latter's productive capacity and makes it easier to preserve safe and orderly working conditions in it. This is especially recognized in foundries where every square foot of floor area is valuable for production and where order and light are essential to the greatest safety of the men.

Orderly Arrangement of Flasks

Order in the foundry yard renders another important service. When, for instance, certain combinations of flasks are needed, workmen can more readily locate and safely move them when they are stacked in an orderly way; but where there is no orderly arrangement, the flask man loses time hunting for or moving the flasks, while the molder is also losing time as he waits for them. Oftentimes. when the required flask is not readily found, a new flask is made or a less desirable one is used, while the proper flask, whole and sound, remains inactive in an obscure place. Order in the yard prevents this wasteful condition.

The surface of the foundry yard should be fairly flat, in order to provide safe foundations for the storage piles of material and foundry equipment. There should be level and smooth footways for safe travel of employes; these also facilitate safe movement of barrows and trucks, with least call upon mens physical strength.

In most cases the yard can be leveled by simply clearing away rubbish and weeds, trimming down slight humps and filling up small hollows. In other yards, however, considerably more work may be involved, and it may then be advisable to clear and level small sections at a time, utilizing for this purpose the time of laborers "between jobs" when they would otherwise be idle; in this way some foremen, at practically no cost, have converted unsafe, unsightly and unused yard space into safe, orderly and useful storage ground. But even though considerable outlay may be necessary to put the yard in service-

able condition, such outlay will prove a wise investment, except under rare and extraordinary conditions.

Permanent walks should be located so conveniently as to *invite* workmen to use them, instead of walking in a shorter, but dangerous path, which may lead over piles of pig iron, scrap or other materials. Cement walks, while best for ordinary purposes, are rarely feasible for foundry yard service; cinder paths are perhaps the most practicable, permanent and satisfactory. They should be free of obstructions and be of ample width to allow clear and easy passage of barrows and trucks. When boardwalks are used, they should be substantial and secure. Cheap, loose boardwalks, which split easily, or warped boards, which slide around, are neither safe nor economical in the end.

Where depressed tracks or roads are apt to cause injuries to workmen, or where furnace pits or excavations expose men to danger of falling into them, suitable guard rails should be provided. For permanent service and where solid foundations are available, pipe guard rails, supported by large floor flanges, are very desirable; permanent guard rails made of pipe may also be rigidly set in the earth by providing concrete footings for the rail posts. Temporary guards of universal application may also be made of pipe, with loose fittings, supported by pointed pipe posts which may be driven in the earth; when permanent guard rails for yard service are made of wood, care should be taken that the construction be strong and that the lumber used in the posts will stand prolonged exposure to the dampness of the earth. Manholes should be covered wherever practicable, preferably with iron or steel cover plates. Such guards prevent accidents in daylight, but are particularly effective where the watchman or others must walk through the yard at night, or in case of fire or other emergency by day or night.

Piling Pig Iron

Up-to-date yardmen have found that the safest way to store pig iron, and especially where the storage space is limited, is to stack each carload in a separate pile. This method preserves the identity of each carload for purposes of analysis, saves room and avoids the danger which is present when the iron is thrown upon high irregular piles, from the peaks of which insecure pigs may become dislodged and fall upon workmen's hands or feet. It takes a little longer to pile pig iron safely, but less time is required to reload it when it is taken to the charging floor.

Sand bins and other permanent bins should be substantially built. Under some conditions the erection of concrete bins is warranted. Whether built of concrete, wood or other materials, or whether intended for permanent or for more or less temporary service, they should be of safe construction and not of a makeshift character. Sand and coke bins, when in a weak or dilapidated condition, are unsafe in themselves and lend a bad moral effect to the yard that detracts from and discourages good order in it.

Where barrels or boxes serve as bins for the storage of borings, turnings and similar materials, these also must be of substantial character. Bins or other suitable storage places should be provided, into which workmen should be taught to deposit old lumber and rubbish, barrel hoops, discarded shovels and other worn-out tools or equipment, instead of throwing them about the yard or buildings or into passageways, where men are apt to stumble over them. The assignment of a definite place for definite things prompts and directs the men to put such things where they belong. Such order promotes safety.

Where materials or equipment are stored alongside of car tracks, sufficient clear space (not less than 18 inches) should be provided between the storage piles and the cars to allow men to walk between them safely.

Scabbing and Rat Tails on Castings

By W. J. Keep

Question.—A stove plate foundry in our vicinity is experiencing difficulty from scabbing on the face of the molds and also on the gates and with rat tails, which consist of serpentine marks on the face of the castings, which I believe is caused by too much charcoal facing on the molds. I have suggested that the scabbing may be due to the gates not being rammed hard enough, thus permitting the cutting of the sand. The mixture consists of 13 per cent of Scotch pig iron high in manganese and 35 per cent of pig iron containing silicon, 2.20 per cent; phosphorus, 1.22 per cent; sulphur, 0.036 per cent; manganese, about 0.60 per cent; graphitic carbon, 3.25 per cent, and combined carbon, 0.50 per cent. The remainder of the mixture consists of gates and return scrap, which contains silicon, 2.58 per cent. phosphorus, 1.02 per cent; sulphur, 0.174 per cent; manganese, 0.46 per cent, and total carbon, 3.07 per cent. Connellsville coke is used with a small amount of anthracite coal.

Answer.—The chief difficulty is that the sand does not contain sufficient venting properties. A liberal use of the vent wire, especially around the gates, will help. A more open sand will prevent rat-tailing. Also, a variation of the gates sometimes will prevent the latter difficulty. The amount of open, new sand added to the heaps also should be increased. The analysis of the scrap used in this mixture shows that the coke is high in sulphur. It is impossible to make good stove plate, or any other castings with sulphur as high as 0.174 per cent. It is difficult to account for the low total carbon, namely 3.07 per cent. The analyses must be incorrect. The puzzling question is, how can a stove foundry use 52 per cent of its own scrap in its mixtures?

Book Review

Investigating an Industry, by William Kent; 112 pages, published by John Wiley & Sons, Inc., New York City, and furnished by THE FOUNDRY, Cleveland, for $1.

This work constitutes a scientific diagnosis of the diseases of management and with a few slight alterations, is a reprint of nine articles published by *Industrial Engineering* during 1913. It discusses the application of the principles of scientific management to all industrial problems, including those of distribution and selling and incidentally treats of some of the causes of the high cost of living. Henry L. Gantt, in an introduction to this work, points out that Mr. Kent has not attempted to place before the public a new idea, but that he simply is elaborating an old one and the entire book is based on the old saying, entitled "look before you leap". He makes clear that it is not only the new enterprises that must be investigated, but that in every established business every function of its operations should continually be known and a knowledge of the advantages or disadvantages it possesses with regards to its competitors should always be available, if possible. The literature on scientific management to a large extent relates to shop practice, whereas Mr. Kent is of the opinion that the term really includes everything concerning a factory or industry. Prof. Gantt is of the opinion that this broad conception of the meaning of the term undoubtedly is correct and he points out that the task of the future is to get this scientific method applied to all industrial problems. The work is well written and its narrative style is conducive to easy and rapid reading.

The production of primary spelter in the United States in 1912 is estimated at 338,630 short tons.

Molding Iron Boiler Bases by a New Method

The Employment of Special Flask Equipment Effects Economies With a Short-Cut Molding Operation

A NEW method for molding cast iron boiler bases in green sand, recently devised by the Union Foundry Co., Fitchburg, Mass., is shown in Figs. 2 and 3. The equipment consists of a circular cast iron flask and a segment wood pattern. The flask is in two parts, an inner and an outer shell, the drag being rammed-up between the inner ring and the pattern, and the cope, or cheek, between the pattern and the outer ring. The segment pattern is bolted to a cast iron arm, which, by means of a collar, revolves around a spindle in the center. The latter consists of 3⅞-inch steel shafting pivoted in a tapered seat in a cast iron block, located in the floor. The arm is in two pieces, which, by means of slotted holes, can be adjusted to secure any desired radius of sweep. The spindle and arm, when the pattern is unbolted from the latter, may be removed by a traveling crane without disturbing the mold. When making the mold, a board partition first is placed against the back end of the pattern, and this partition is left in place until the molder is ready to ram the last segment. At the forward end of the pattern is placed a wood stripping plate. After the first segment has been rammed, the pattern is swept through the stripping plate and the latter is then removed and again set in place at the forward end of the pattern, when another segment is ready to be rammed. In this manner, one segment after another is rammed until the mold is completed.

The boiler base, by this method, is molded bottom side up; hence, the lugs for supporting the grate ring are located at the bottom of the mold. These lugs are provided for by placing hollow, two-piece, dry-sand cores against the inner side of the pattern at regular intervals and making them an integral part of the mold. In Fig. 3 is shown the method of placing one of the gates. Two gates are provided, each having a separate sprue. The gates are hollow dry sand cores of square cross-section, which are placed against the inner side of the pattern at a height of about 4 or 6 inches above the bottom of the mold, which is provided with four risers, conveniently located.

Rows of gaggers are placed at the bottom of the mold, close to both the inner and outer circumferences of the pattern. Gaggers also are placed similarly at the top of the mold. When the mold has been completed, the segment pattern, sweep arm, and spindle are removed and the cheek is lifted off by a traveling crane. After the mold has been faced, the cheek is replaced and the mold is closed with dry sand cores, made in segments to fit the top. These cores are wedged in place by circular plates and binders.

The ash-door openings in the base are provided for by a make-up frame, which is placed in position in the mold after the cheek has been lifted off. The cores which correspond to

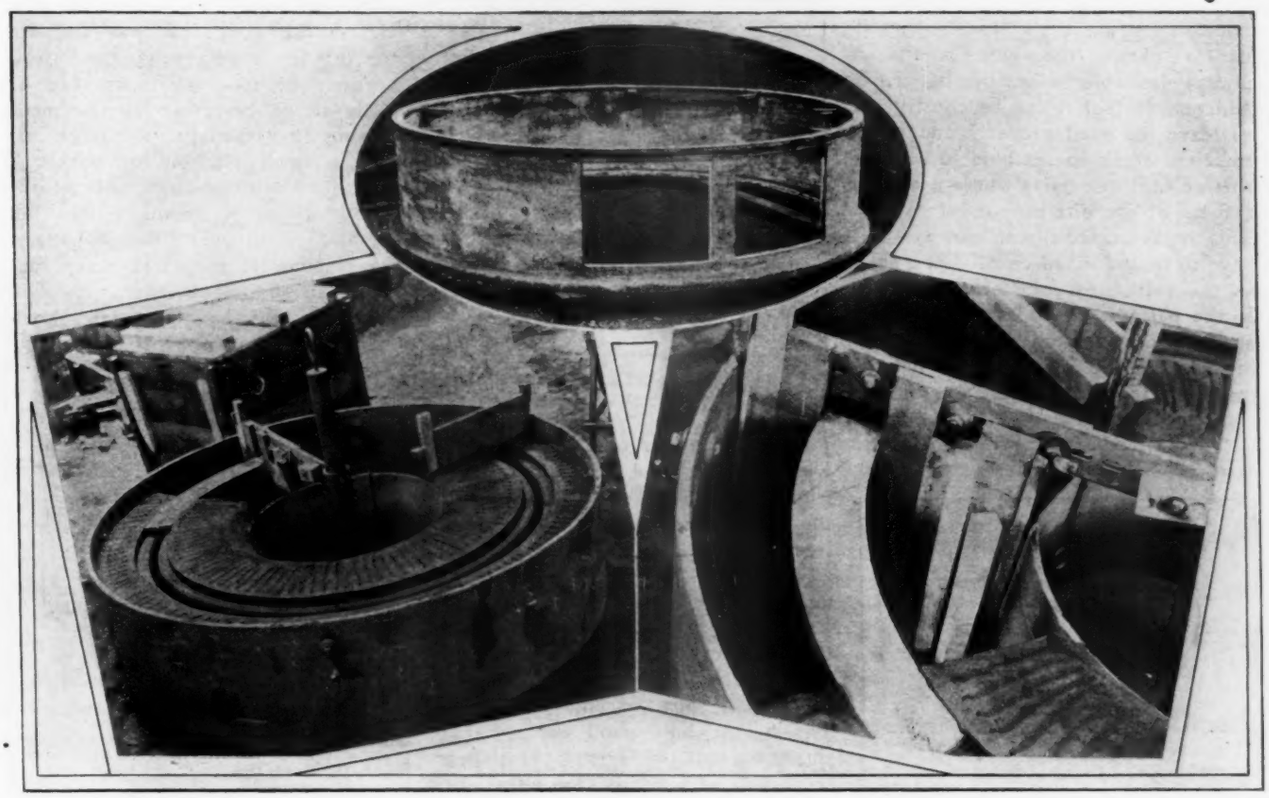


FIG. 1—A 74-INCH BOILER BASE CASTING

FIG. 2—BOILER BASE MOLD SWEPT-UP IN SEGMENTS

FIG. 3—METHOD OF PLACING GATES IN BOILER BASE MOLD

the door openings are swept-up in this frame, after which the latter is removed.

The Union Foundry Co. makes boiler bases in 42, 48, 61, 74 and 80-inch sizes, which vary in weight from 600 to 3,400 pounds each. Figs. 2 and 3 show the molding equipment adjusted to a 74-inch base, the casting being shown in Fig. 1. It requires from two to four days to make one of these molds. The diameter of the outer ring shown in Figs. 2 and 3 is 8 feet, while the height of the flask is 26 inches. The outer ring is provided with a bottom flange for supporting the sand. This flange contains a number of holes, which are used as a fulcrum for the lever by means of which the segment pattern is moved forward.

The Proper Construction of Patterns

By Paul R Ramp

IS THE manner in which a pattern is made exercises an important influence on the possibility of obtaining castings free from dirt, blow-holes and shrinkage cracks, a consideration of how it is to be molded to obtain the best results is always desirable before the pattern is laid out, so that it can be constructed to leave the sand properly and allow sufficient stock to machine to a clean surface on those parts where a certain amount of fine dirt cannot be avoided. This applies especially to castings that have to be machined on all sides, such as the valve gear of Corliss engines. If the patterns are not properly constructed, the castings may come dirty in spite of the best efforts of the molder. In addition to the proper construction of the pattern, the sand has to be tempered carefully for such castings; it must not be too wet, otherwise the metal will boil in the mold and cut off parts of the mold surfaces, which, however small, will rise to the top of the metal and will be carried to the highest point of the casting, forming a sand pocket, that will be sure to show up badly when an attempt is made to polish the casting. In the case of a double steam arm for the valve gear of a Corliss engine which is machined all over and polished, sand holes can be avoided by the proper construction of the pattern. A pattern of this kind is shown at *X* and *Y*, Fig. 1. The casting is molded in the position shown at *Y*. Extra stock for finishing, about double the amount allowed on the drag side, should be left on the cope side. Regardless of how careful the molder may be, or how good the metal, a small amount of very fine dirt or dross will be found on the upper surface. This is due to the fact that every particle of foreign matter that enters, or is created in the mold, will rise to the top, and the hotter the metal the more readily it will rise. The pattern should be made and finished so that it will not be necessary for the molder to patch the mold after it has been drawn from the sand. On green sand work the more a mold is patched and slicked with tools, the greater the danger of scabbing, as the slicking has a tendency to close-up the grain of sand, which prevents the free egress of the gas generated by the metal.

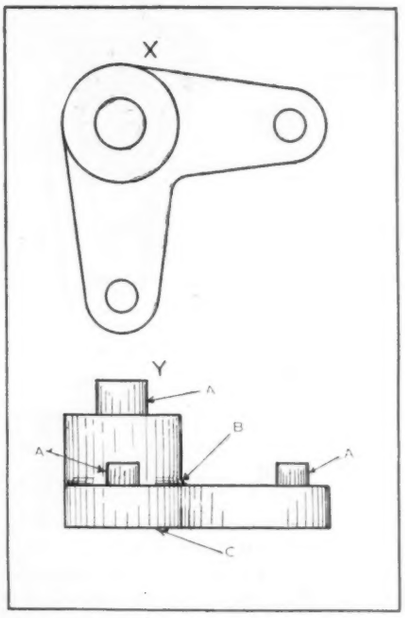


FIG. 1—PATTERN OF A DOUBLE STEAM ARM FOR ENGINE VALVE GEAR

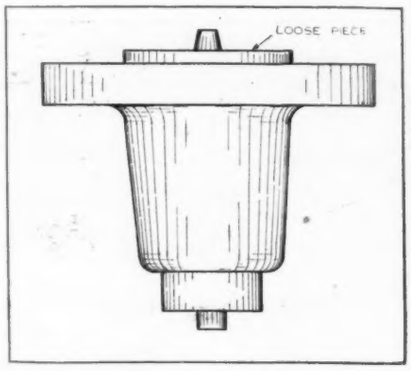


FIG. 2—SOLID PATTERN FOR ENGINE CYLINDER VALVE BRACKET

When the hub and prints on a pattern, such as shown in Fig. 1, are carelessly turned, they tear the sand when the pattern is drawn and the mold requires patching, which is usually accomplished by swabbing to repair the defects of the mold. The mold, therefore, has to be slicked and additional water is added to the sand. Unless the sand first was tempered too dry for good results, the patched portions become too damp, and are likely to be cut away by the metal, causing dirty castings. On large castings a small pin-hole or pocket of sand is not noticeable, but it is a serious defect on small castings that are finished all over. Rough patterns are responsible for more dirty castings than any other cause. It is not only important that the pattern should leave the sand smooth and clean, but it is also necessary that it should be

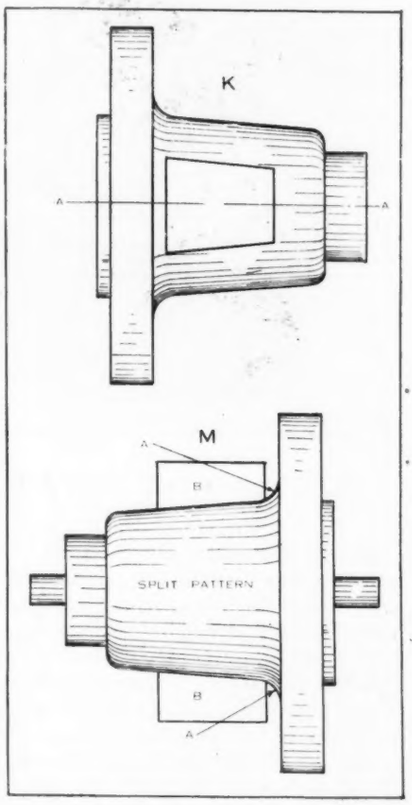


FIG. 3—SPLIT PATTERN FOR ENGINE CYLINDER VALVE BRACKET

constructed properly with reference to the method of molding.

For example, *K*, Fig. 3, is a valve bracket for a Corliss engine cylinder, which is made, in many cases, split through the line *A A*. The pattern then assumes the form shown at *M*, Fig. 3, and a narrow ledge of sand left at *A A*. The mold is made as shown in the cross-section, Fig. 4. The two core prints, *B B*, increase the difficulties of molding by adding the liability of a crush, which is further enhanced by the small ledges of sand at *A*. The gas cannot escape from the core as readily as if the casting were molded upright, and if the core is too hard, small bubbles will form in the casting at *E*, causing pin holes. The top of the casting is also liable to shrink, or may contain a blow-hole if the sand is rammed too hard at this point. In addition, there is always danger of the mold cutting at the inside of the flange, *G*. The flange in the drag will swell under the pressure of the metal, which results in the uneven distribution of metal in the casting.

The best method of constructing this pattern is shown in Fig. 2, and a cross-section of the mold containing this pattern is shown in Fig. 5. Molded in this way there is no danger of dirt on the polished parts, and less danger of dirt on the joint surfaces where the casting is attached to the cylinder. There are no core prints to contend with at *A A*, as the core is made to fit inside of the mold. Furthermore, the core is vented to the top of the mold. Made in this manner, there is absolutely no excuse for a crush or a drop-out. The flange can be vented properly, and no shift of the pattern is possible. This method of molding gives much better results than when a split pattern is used.

The Height of a Cupola Bed

By W. J. Keep

Question.—Our cupola is lined to 48 inches and we would like to know whether a bed extending 45 inches above the tuyeres will produce metal higher in carbon, silicon and sulphur than a bed, 32 inches high, using 50 per cent iron and 50 per cent steel scrap.

Answer.—I can see no reason why an increase in the depth of the bed will produce the results indicated in your inquiry. There is no necessity for using the bed as deep as 32 inches. The coke below the tuyeres is intended merely to hold the iron above the melting point, which is about 15 inches above the tuyeres. This coke, namely between the tuyeres and the melting point, is burned to melt the iron. The coke between the next charge of iron comes down and takes the place of the coke that was burned and thereby maintains the melting point at approximately the same place, namely, 15 inches above the tuyeres. If you start with the coke 32 inches above the tuyeres and with the first charge of iron on the bed, the coke that occupies the lower 15 or 17 inches must burn out before the iron comes down low enough to melt. For this reason your iron is slow in coming down. If you make the subsequent coke charges too large, the surplus coke must burn out before the iron comes low enough to melt. Ascertain what your cupola will do and work in that direction. If you use an insufficient amount of coke, your iron will not be sufficiently hot.

Replying to your question regarding an increase in carbon, sulphur, etc.: The pig iron was produced in the blast furnace hearth, which is much hotter than that of the cupola and it has taken up all of the carbon and silicon that it can hold at that high temperature. When this iron is melted in the cupola, the temperature is so much lower that the pig iron will drop some of its carbon and silicon and it cannot take up any more. Steel can take up both carbon and silicon, but it melts and mixes with the molten pig iron so quickly that it does not have time to take up either. Carbon, silicon and manganese will be decreased by melting the iron in the cupola, but sulphur will be increased. By using more coke than is absolutely necessary, sulphur is increased considerably and even under ideal operation, sulphur is absorbed from the coke.

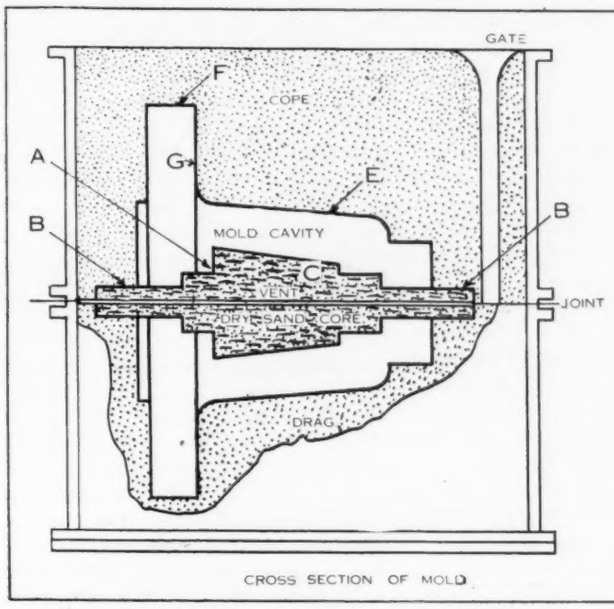


FIG. 4—CROSS-SECTION OF MOLD, CONTAINING SPLIT PATTERN

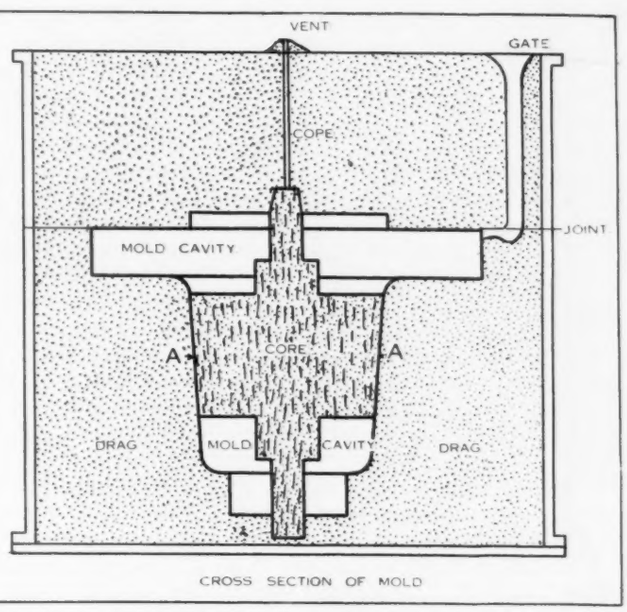


FIG. 5—CROSS-SECTION OF MOLD CONTAINING SOLID PATTERN

Lead Alloy

A patent recently was granted to Charles P. McConnell, of the Western Electric Co., New York City, on a lead alloy which can be utilized for rolling into tape for winding electrical conductors, such as telephone switchboard cables. This alloy consists of lead, 95 per cent; antimony, 4.50 per cent, and tin, 0.50 per cent.

Efficiency in the Plating Room

By E P Later

AS BUSINESS increases and the amount of work to be done grows in volume, every plating establishment, sooner or later, is confronted with the necessity of providing more capacity and increased facilities. In such a case probably the first thought is to install more tanks, which may necessitate moving into larger quarters, and thus make available a larger amount of equipment. While this is one way of solving the problem, it does not follow that it is the best one, and experience has shown that in a great many instances it really is the poorest and most expensive way out of the difficulty. Tanks, switchboards, wiring and floor space are expensive luxuries and should be regarded as such, no more being installed than is absolutely demanded by the requirements of the business. Of course, if a manager wishes to invest in more equipment than is actually required, to provide for future growth, that is another problem which will not be discussed in this article.

Increasing Facilities of Plant

From the foregoing it is obvious that if we do not wish to install additional equipment, we must seek to find some way of increasing the efficiency of that which we already possess, and it is the purpose of this article to indicate some of the ways by which this may be done. As an instance of what may be accomplished along these lines, the experience of a western plant may be of interest. Some time ago the manager had his attention directed to the fact that the plating department was apparently too small to take care of the volume of work which had been steadily increasing for some time; in fact, the department was fairly swamped. As the foreman plater could suggest no other remedy than installing new tanks and other apparatus, a plating room, covering considerably more space and containing a large amount of new equipment, was planned. Business was good, but when the manager saw the estimated costs of these changes, he could not keep a certain chilly sensation from promenading up and down his spine and the temperature inside his shoes fell several degrees in a few seconds.

A few days later, while he was still debating whether or not to recommend such an expenditure, he met a friend and in the course of the conversation told him of the contemplated improvements. His companion at once informed him that this could probably be cut down materially, and in order to settle the dispute which arose, offered to go over to the plant and demonstrate the truth of his statement. The manager pointed out, with a good deal of confidence, the piles of parts scattered here and there, waiting to be finished, the tanks apparently loaded to capacity and the workmen bustling back and forth, evidently working as though their lives depended on it. The visitor took it all in silently; then he quietly pointed to one of the ammeters, which, like most of the others, was giving a ridiculously low reading; he pulled a string of parts out of one of the tanks and showed how twice as many pieces could be put on with no additional trouble. By a few judicious questions he disclosed the fact that a large number of brass parts were being given a heavy coating of nickel, thereby tying up the tanks and consuming time, power and chemicals needlessly, since they were plated merely for the sake of appearances, and a good flash would have done just as well as the thick deposit which they were getting. Incidentally, he told the manager to watch one of the helpers who was racing around like a caged lion and apparently doing two men's work. Closer inspection revealed the fact that his prodigious energy was mostly bluff, though perhaps an unintentional one, as he really accomplished little. He would grab up a few parts and hurry around, dipping and cleaning them, when he might have performed a good deal more with far less effort, by taking as many parts as he could handle easily and doing his work steadily and without strain.

The Manager Convinced

By this time the manager's eyes were sticking out like knots in a pine board, and when his friend showed him how awkward and inconvenient was the arrangement of some of the tanks and cleaning solutions, he narrowly escaped apoplexy. The next day he had a heart-to-heart talk with the foreman and ordered certain inexpensive changes, with the result that the output of the plating room was increased about a third and the new plans were thrown in the waste basket, since they were no longer needed. There are few plating rooms where similar reforms cannot be made, not so great, perhaps, but still large enough to deserve consideration.

A little reflection will show that there are a great many ways in which time, power, chemicals and other commodities may be wasted in a plating room and thereby reduce its efficiency. Obviously, a discussion of each of these is impossible, but there are a few to which attention may be directed particularly. In the writer's estimation, an important one is in the use of too low current densities, thereby lengthening unduly the plating time and tying up expensive equipment when it might better be making a good profit for its owner. Just because a copper

or nickel bath will produce a nice-looking deposit upon articles which are hung in it, is no sign that it is working at its full capacity and, therefore, most economically. In the good old days when things moved more slowly than they do now, when time was no object and labor was cheap, heavy currents were practically unknown, and the plater was forced to let articles plate for hours, but such methods are now as obsolete as hoop skirts and powdered wigs. We can no longer afford to unload a car of coal with a scoop shovel; we use an electric crane or ship it in cars with movable bottoms or sides. And so in electro-plating, comparatively high current densities can and should be employed. Of course there is a limit beyond which it is not safe to go, but most platers could use much higher densities than what they ordinarily do and get just as as good or better work at a great saving in time, which is equivalent to saying they could get along with less equipment.

The Current Problem

When a current is applied to a solution of a metallic salt, it must be of a certain voltage or pressure before it will decompose the salt into its constituent parts. This minimum voltage varies with the different metals and is called the decomposing pressure. For solutions containing one combining weight of the salt per liter, these values have been found: Zinc sulphates, 2.35 volts; nickel sulphate, 2.09 volts; silver nitrate, 0.70 volt, and cadmium sulphate, 2.03 volts.

We might illustrate the principle of this by citing the case of a board supported at each end by bricks. It is apparent that it will support a certain and very definite number of pounds without breaking, but when a weight even slightly in excess of this is placed on it, it promptly gives way. Going back to solutions again, it can be seen that it is not possible to run baths plating different metals all at the same voltage. For various reasons, which cannot be discussed here, it is not advisable to operate a bath at a voltage too greatly in excess of its decomposing pressure. Having now established the proper voltage, we are confronted with the problem of the speed of decomposition, which is dependent on the amperage or amount of current actually conducted through the solution. Thus, one ampere at a pressure of three volts, for example, will deposit a certain definite weight of each metal in a given space of time. Like the decomposition pressure, this weight varies with the different metals. If we lower the resistance in some way and allow two amperes to pass through the solution, still maintaining a pressure of three volts, we will get just twice as much metal deposited in the same time as we did before. Therefore, we see that the weight of metal deposited in a given time varies directly as the current passed through the bath. In other words, if we obtain a certain weight of deposit per square inch in an hour—say, with 10 amperes per square foot—we can obtain the same deposit in one-half hour with 20 amperes per square foot or in 15 minutes with 40 amperes per square foot. This means, that allowing for the time of loading and unloading a tank, we can obtain two or three times as much work out of a tank by the use of high current densities as with low densities.

The saving in investment and floor space under these circumstances hardly need be mentioned.

It must not be inferred, however, that the current density can be increased indefinitely and the time correspondingly decreased, for as every plater knows, too high a current produces a rough, coarsely crystalline, or *burned* deposit, which is objectionable. This tendency is greatly reduced, however, by agitating the solution during the plating, either by bubbling compressed air through it, or mechanically, by a pump, which keeps it in constant motion, or by some device to rock the cathode rods back and forth. Such a scheme is not costly, yet it will increase the capacity of a tank greatly.

Question of Current Density

Before anything of this kind can be figured on, however, it is necessary to know the current density which is ordinarily used and that is something which few platers know. It is not very hard to calculate and is of great help to the operator as it enables him to work much more intelligently. The writer has often seen nickel baths, for instance, worked at five or six amperes per square foot, when they might better have been run at twice or three times that amount, with a corresponding increase in capacity. It is true that certain parts, from their shape, tend to burn more readily than others, and again, some baths will not admit of being worked at as high densities as others; but every plater should determine the maximum current density consistent with good work and then operate his baths at that figure. Electro-galvanizing solutions have often been worked at less than 20 amperes per square foot with the production of a very mediocre deposit, while some of the secret or patented solutions put out by various concerns give a fine bright coating at densities ranging from 40 to nearly 60 amperes; and these instances might be multiplied almost indefinitely. At best, electro-plating is subject to large wastes of power and materials, which are practically unavoidable; therefore, it would seem to be a solemn duty for everyone to make it just as efficient and economical as possible.

Not Enough Parts

Another mistake which is often made is in not working the solutions at their full capacity; in other words, not putting in enough parts. It takes just about as long to plate 10 parts as it does to plate 500, assuming that the current density is the same; so we might as well get all we can out of our tanks. A business man considers that any investment which is not making him a profit, is a loss, and in the same way the plater should feel that any bath which is not being operated at full, normal capacity is losing money one way or another. The proper thing to do, then, is to operate all plating solutions at as high a current density as possible and to put as much work in the tank as is advisable. The writer realizes that on account of the varying amounts, conditions and requirements of the work, it is not always possible to obtain this ideal, but that is no reason why we should not do the best we can.

There is, of course, a limit to the amount of current which it is possible or advisable to pass through a solution and this amount varies with the different metals and various formulae for plating baths. Some solutions will conduct more readily and stand much heavier currents without injury than others; therefore it may be well to see if the old one you are using is the very best that can be obtained. Perhaps the addition of some conducting salt or other slight change will improve it greatly. Anyway, it is worthy trying.

Impoverished Solution

One thing which needs to be borne in mind when working a bath heavily is that the metal often deposits on the cathodes considerably faster than it is dissolved from the anodes, so the solution becomes impoverished in metal. It is advisable, therefore, to determine frequently the amount of metal present in the solution, by the methods recently described in THE FOUNDRY and if necessary, add suffi-

cient salts to bring the metal content up to normal. The use of more anodes will tend to decrease the resistance and keep the amount of metal in the solution up to its proper figure. Needless to say, pure anodes which dissolve easily and uniformly will be of great help in keeping a bath in good working condition.

Poor Connections

Another source of loss which may, and often does, become serious, is the waste of power due to poor connections and corroded contacts. High voltage currents are able to pass through resistances which would absolutely smother the low tension, high amperage currents used in electroplating. The atmosphere of a plating room, even when ventilated as thoroughly as possible, is highly corrosive and all electrical contacts must be scraped and cleaned frequently; otherwise the resistance becomes so great that it seriously interferes with the plating. All permanent connections on cables, bus-bars and the like always should be soldered or otherwise protected, but in an astonishing number of cases no particular effort seems to have been made to protect such joints from corrosion. It is not very difficult to measure the resistance between the various connections from the dynamo to the tanks and such a test will often show that too large a proportion of the current generated is wasted in overcoming the resistance of the joints. It is evident that such a condition causes large and needless loss. Dirty anode and cathode rods, too, are often a source of large losses of energy. They are generally of brass, sometimes copper, and a thin film of oxide forms on them in a very few hours; as this offers a comparatively high resistance to the passage of a current, it is not unusual to find that a large proportion of the anodes in a tank are getting little or no current; this may be demonstrated by touching them, one at a time, with a file which is in contact with the cathode rod. It is a good idea to give anode hooks a bright dip, often enough to keep them in good condition, while the anode rods should be scrubbed frequently with some scouring material. Cathode rods should be wiped with a damp cloth after the removal of each load of work.

Small Conductors

In this connection it may not be out of place to mention another more or less frequent condition resulting in the loss of electric energy, namely the use of too small conductors. Any cable or wire which heats to any extent while current is passing through it, is too small and should be replaced if possible. Of course, the proper time to look after such things is when the plant is being designed.

Turning now to a slightly different phase of the subject, it needs no argument to prove that a poorly designed plating room and the haphazard handling of work by unskilled laborers may contribute largely to the low efficiency of an establishment. If a helper has to go to one end of the room for the potash tanks, then over in the farther corner for the bright dip, and somewhere else for the cyanide, it is evident that he wastes most of his time and energy transporting himself and a few pieces of work around the room. Since you are paying for his time and strength, you might as well get the good from them, which you can do by arranging the cleaning and plating tanks so that he does not have to run a marathon every time he loads a tank.

Lastly, all work should be sent through the plating department according to some definite and systematic routing and not shifted here and piled there at anybody's whim. Incoming work should be piled in one place until needed, then handled according to some system which will accomplish the desired results with the least effort and when finished sent at once to the buffing or stock room. A room which is littered with work in all stages of finishing, not only looks bad, but is difficult to get around in, while a clean, neat place is more inspiring to the workmen, lessens the danger of parts becoming injured or lost and conserves the large amount of time and energy which otherwise is expended in sorting and handling them over and over again.

All of these points may seem to be small, and perhaps they are, individually, but taken altogether, they may make all the difference between a business which barely keeps going and one which pays a good profit.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Enamel for Automobile Radiator Cap

We make an aluminum cap for automobile radiators and find that the ordinary black enamel used for other parts of the machine does not wear well on this cap. We would like some information as to where we can obtain an enamel which will be hard enough to use for this purpose.

You no doubt will experience considerable difficulty in obtaining a durable coating of enamel on the aluminum cap and only soft, common enamel can be employed, as the hard, glass-like enamel, such as used for art enameling, will not adhere to the aluminum, even if applied by hand. If the cap could be made of pressed steel, the porcelain enamel could be employed or the art variety could be used on a nickel steel cap. If you must continue the use of the aluminum cap, we would advise a celluloid enamel or lacquer, applied by spraying, as by this method as many coats as required could be applied, each successive coat being of uniform thickness and the previous coating remaining unattacked, which is not the case when the coatings are applied by a brush or dip.

Anode Mixtures

Kindly furnish us with a mixture for nickel, brass, copper and bronze anodes.

The standard commercial nickel anode is manufactured from about 92 per cent pure nickel and 8 per cent iron, while in some the ratio is 94 and 6. While for certain classes of work the mixture is 85 to 87 per cent nickel and 15 to 13 per cent alloy, the formula used by a large manufacturer of anodes consists of nickel, 90 per cent; iron, 7 per cent, and tin, 3 per cent. In making nickel anodes it is advisable to add the iron in the form of old files or similar metal, as this is

high in combined carbon and melts more readily. For a flux use one part fluorspar and three parts lime. After the nickel and iron are melted pour into ingots and remelt, but just before the second pouring add the tin and pour into dry sand molds. The metal should be poured hot and the mold should be dry and hot. French sand makes the best molds, as it contains a large proportion of lime and dries hard.

Brass anodes are made from 66 parts electrolytic or lake copper and 34 parts spelter for good yellow brass, while the composition may be altered according to the shade of yellow desired, though this is not essential as the color of the deposit may be regulated by the composition of the bath and the application of the electric current.

Copper anodes usually consist of either sheet copper or electrolytic copper, the latter being preferable on account of its purity, while if cast copper anodes are desired the electrolytic copper may be melted and cast into the required shape. In any case pure copper only is the only requisite for a good copper anode. You can make the copper anodes close-grained by casting in sand and adding eight ounces of silicon-copper to each 100 pounds of ingot copper. It is better, however, to use pure copper only and then sand-blast or acid-dip to obtain a clean or bright surface.

Bronze anodes consist of from 88 to 90 parts copper and 12 to 10 parts tin or zinc. Very few contain tin, as equally good results are procured from those made with zinc, while many platers use an ordinary brass anode in a brass bath rich in copper. If you melt the brass or bronze in a crucible use salt as a flux. It collects the oxide of zinc formed and a coating on top of the metal results, which prevents further oxidation. Fluorspar should be used if the brass or bronze is melted in an oil reducing furnace, in which case the temperature is usually too high to admit the use of salt.

Matte Surface on German Silver

We desire to produce a rather rough surface on German silver by means of a solution used cold.

A matte surface on German silver may be obtained with a solution consisting of one gallon of nitric acid, one gallon of sulphuric acid and one-half gallon of water mixed and allowed to cool, with the addition of one-half pound of finely pulverized rock salt. Use the dip as for ordinary matte dipping of brass and replenish in a similar manner.

How to Remove Nickel Plate

We desire a solution or mixture that will remove nickel plate from brass castings.

If an electric current of low voltage (from 5 to 12 volts) is available, the following method of removing nickel deposits from brass castings is superior to ordinary acid dips or mixtures. In a stoneware crock or other suitable vessel which will resist the action of the solution, prepare a quantity of hydrochloric acid diluted with an equal volume of water. Across the top of the tank or crock place two brass or copper rods strong enough to sustain the weight of the castings. To one rod connect the positive pole of the current source and to the other rod connect the negative, then suspend a piece of sheet lead from the negative rod and use the lead as the cathode and the castings as anodes. No other equipment is necessary. Free the castings from grease or oil by washing with lye and suspend them on the rod by copper or brass wire hooks and all portions immersed in the solution will be cleaned quickly of any trace of nickel. Two lead sheets may be used, one on either side of the castings, thus hastening the operation. Ordinary deposits should be removed in from one to three minutes with a five-volt current. The distance from the casting to the lead will depend on size of container used and size of casting treated. If the deposit is removed in patches it denotes an uneven coating and the pieces should be slowly turned during the treatment. No obnoxious fumes are liberated as in other processes of similar nature. A boy can easily strip brass parts by this method and the surface of the casting will not require emery polishing to refinish.

If an electric current of low voltage is not available, the nickel may be removed by either of the following mixtures: Sulphuric acid, 4 parts; nitric acid, 1 part; then add only sufficient water to create a quick action when brass piece is immersed. This solution should be used warm and if carefully employed will remove the nickel evenly and leave the brass surface smooth and in a condition to easily refinish. If the brass surface becomes roughened by the treatment, add more sulphuric acid and a small amount of nitric acid, but avoid the introduction of more water. If the brass is not required smooth, or if the treatment is to be quickly performed, prepare the strip of the following proportions: Sulphuric acid, 3 parts; nitric acid, 2 parts, and a small quantity of water. This solution will act quite readily cold on light deposits, but its action is hastened by heating either on a sand bath or by submerging the vessel in hot water. Lead coils may be inserted in the solution and the heat obtained from steam. The castings should be closely watched while being stripped, as the action of the acids upon brass is rapid. When the nickel is removed, rinse the castings in cold water and pass through boiling water to dry. The above methods are those in general use and are practical, as well as simple.

Use of the Hydrometer

Is the common hydrometer used by nickelplaters considered a reliable instrument to use when testing the density of a solution? How can the amount of nickel in solution be determined by use of hydrometer?

From a technical viewpoint, the common hydrometer, as used by platers, is merely an ancient instrument used in an unreasonable manner, because it has been handed down by the old school of platers and is used today for the reason that the *boss* always used it. Five-and-a-half or 6 degrees on the hydrometer simply indicates that a nickel solution is 5½ or 6 times heavier than water, volume for volume, but does not enlighten the plater in regard to what material caused the increased weight. When making a new solution from reliable salts, the plater knows that the salts dissolved have been responsible, but with a solution which has been working for six months or longer, the hydrometer, as ordinarily used, is of little consequence unless a table of comparative scales be consulted and the significance of the specific gravity reading be understood with reference to the particular case. In any event, it is necessary to determine the metallic content by analysis as the acids, alkali, iron, etc., all influence the hydrometer scale reading and thus the metallic content is not alone indicated. The analysis of such solutions, though simple, requires the use of delicate scales or balances to determine the amount of metal recovered from a given quantity of solution. The metallic content, or at least the normal working condition of a solution, may be judged approximately by the results obtained with a given current, together with the general appearance of the solution and anodes; but if you are situated so that you can possibly study the scientific methods, we strongly advise you to do so. The other method is not practical in this age of progress.

Sawing Gear Teeth

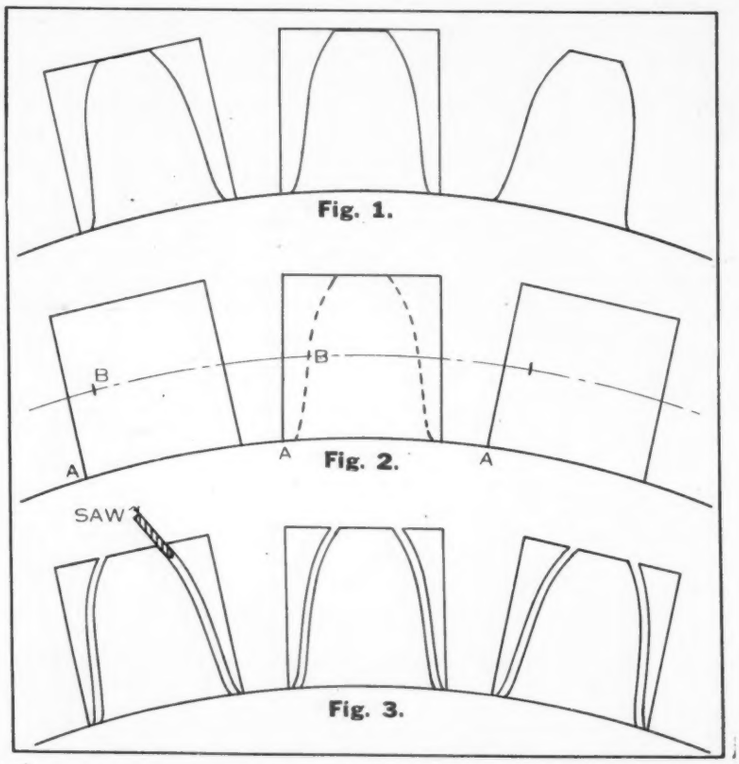
By C. Ray

The method of making gear patterns that will be described herewith may not meet with the approval of some patternmakers, but it is branded with the O. K. of the molders, one of whom claimed that he could draw a 60-tooth gear with his eyes shut because the draft is so uniform. One of the essential features of sawing gear teeth is that the draft is the same on all teeth, eliminating the necessity of loose teeth used for patching the mold. When making gear teeth in this way, the blank is turned up, either from the solid wood or is made in segments, according to the size of the gear required. The outside diameter of the blank is the diameter of the gear at the root of the teeth, and not more than 1/64 inch draft is required for a gear having a 4-inch width of face. To ascertain the size of the blocks required for the teeth, a full-sized layout of a section of the rim and two or three of the teeth is made, as shown in Fig. 1, and the blocks should be made wide enough to allow ⅛ inch of material or less on each side of the tooth and thick enough to provide the proper depth of the tooth without being fitted to the curve. Some patternmakers get out the blocks to rough thickness and then turn the tops of the teeth, but I am of the opinion that the method outlined effects more rapid production. Cutting the teeth from long strips and running them diagonally across the circular saw insures the best job of fitting, but if only a few teeth are required, these can be hollowed more rapidly by hand. After hollowing, they are cut rough length and are trimmed on both ends to the exact width of the gear face. The gear is spaced off and blocks are glued in position with one side to the spacing, as shown at *AA*, Fig. 2, the smooth end being toward the cope side.

On small gears we frequently glue on the teeth before the blanks are taken from the face plate and by pursuing this practice the teeth can be set square across the gear face by merely setting down the end against the face plate without the necessity of squaring the spacing across the gear face by which to set the teeth. The cope ends of the blocks next are coated with shellac and when dry the pitch circle is struck and is accurately divided for the number of teeth required. To obtain the most accurate results, the spacing can be stepped-off near one side of the blocks, rather than in the center, and these points can be used as locations for one side of the teeth, as shown at *B*, Fig. 2. The teeth next are laid out by dividers, templets or other means, with the proper allowance for backlash.

We make it a practice to lay out on the cope side, if possible, to facilitate the subsequent sawing, as this insures a small amount of extra tooth clearance on account of the draft. When sawing the teeth, the band saw table is tilted slightly to the right while cutting the left side of the teeth and to the left when cutting the right side, it being presumed that the teeth have been laid out on the cope side. The amount of tilt to the table can be determined by using a block about the thickness of the gear face and trying with a square until the right amount is obtained. At best, the amount of tilt need only be slight. The teeth after sawing are shown in Fig. 3 and the sides will be found to be so smooth that very little sandpapering will be required before varnishing. The pieces, shown in Fig. 3, are broken off, the teeth sandpapered and after the first coat of shellac is applied, a small wax fillet is run in the corners at the root of the teeth.

A few suggestions with reference to the sawing may prove helpful. A saw with the wire edge worn off cuts smoother than one that has just been filed, and if the saw is steadied back of the teeth by the part of the gear tooth already cut, as indicated in Fig. 3, the teeth will have smooth curves and the layout marks will be split through the center. This method will give satisfactory results on both fine and coarse pitch gears, that is, from six pitch upward. The 60-tooth gear, previously referred to, which had 1¼-inch circular pitch, was of the internal gear type. To effect the sawing of the teeth the band saw was cut and again brazed with the gear blank on the table in the proper position for sawing the teeth. After this job was finished the saw was again cut and rebrazed. To guard against careless handling in the foundry, the teeth, after being sawed out, are attached to the rim of the gear with brads.

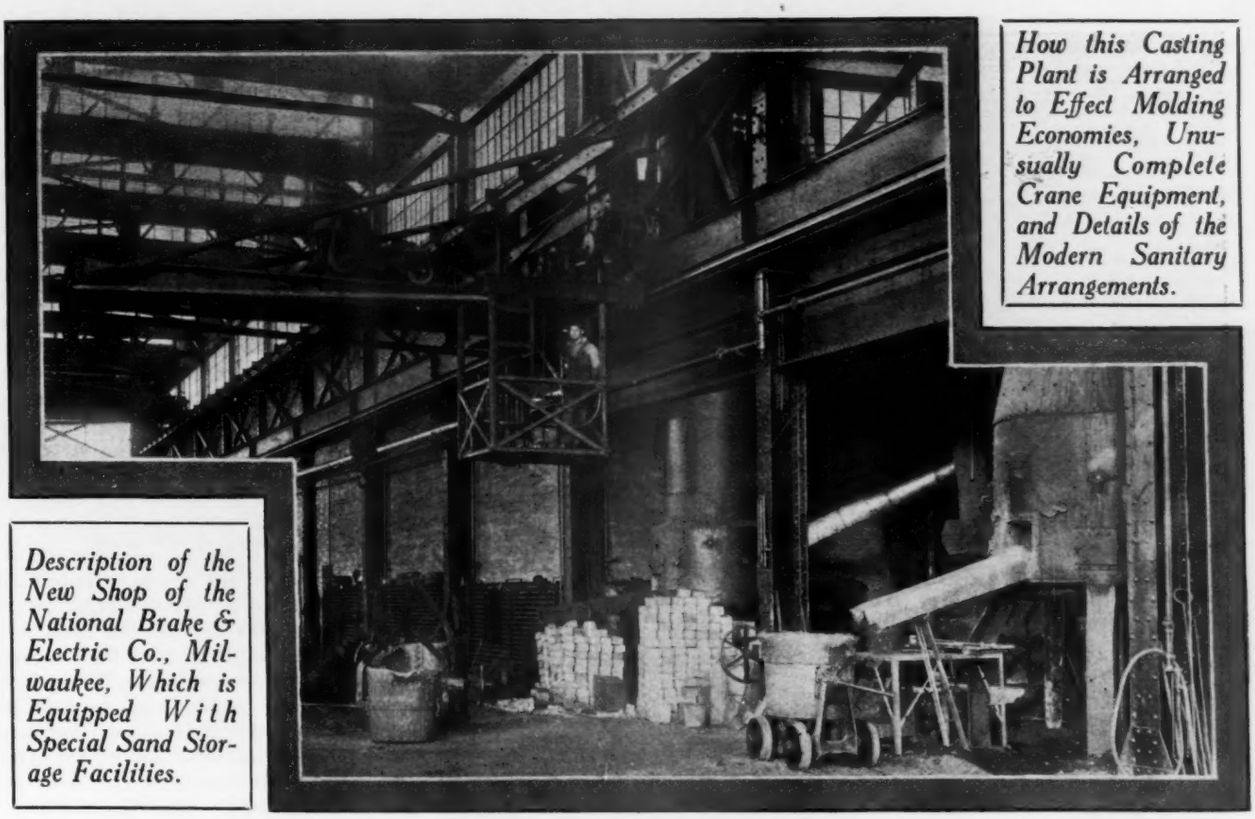


SKETCH OF THE SEVERAL OPERATIONS REQUIRED IN CUTTING GEAR TEETH WITH A BAND SAW

A Malleable Zinc Alloy

According to an invention of Thomas A. Bayliss, of Warwick, Eng., a malleable and tough alloy is produced from zinc, aluminum and lead when the ingredients are present in proportions between the following limits: Zinc, 99.1 and 99.9 per cent; aluminum, 0.001 and 0.1 per cent, and lead, 0.01 per cent. It is claimed that the metal thus obtained is extremely tough and strong and is suitable for stamping purposes.

Victor bronze was invented by Victor Lassen many years ago. The formula follows: Copper, 50 per cent; zinc, 35 per cent, and nickel, 15 per cent. Two ounces of aluminum should be added to this mixture.



How this Casting Plant is Arranged to Effect Molding Economies, Unusually Complete Crane Equipment, and Details of the Modern Sanitary Arrangements.

Description of the New Shop of the National Brake & Electric Co., Milwaukee, Which is Equipped With Special Sand Storage Facilities.

Fig. 1—Cupolas With Wall Crane For Handling Ladle and Molds

A Modern Wisconsin Gray Iron Foundry

A GRAY IRON foundry with unusual sand storage facilities in the basement underneath the core room has been completed at Milwaukee by the National Brake & Electric Co. This shop also has a number of other interesting features. It is built on a tract of land which slopes abruptly to the Milwaukee river and due advantage of the topography was taken in laying-out the various departments. The plant has a rather large molding floor area, compared with its output, due to the character of work handled. The new foundry is the outgrowth of an old castings shop and is a part of an extensive plant which occupies

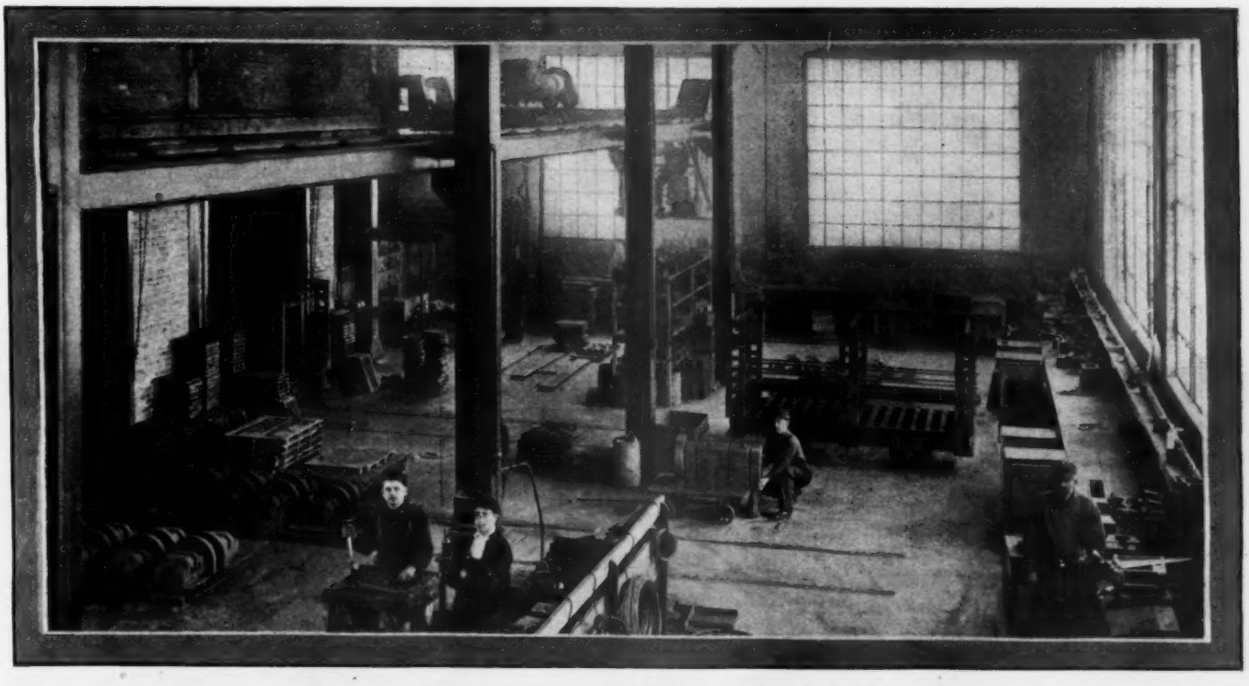
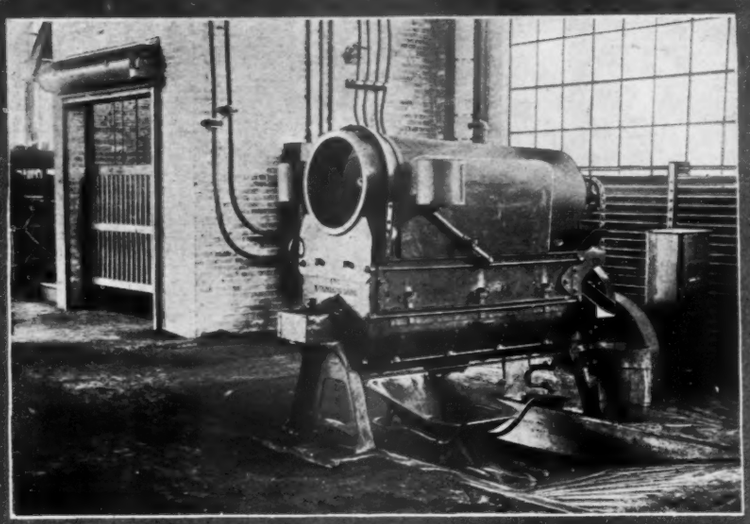


FIG. 2 — A VIEW OF THE CORE ROOM, SHOWING THE OVENS



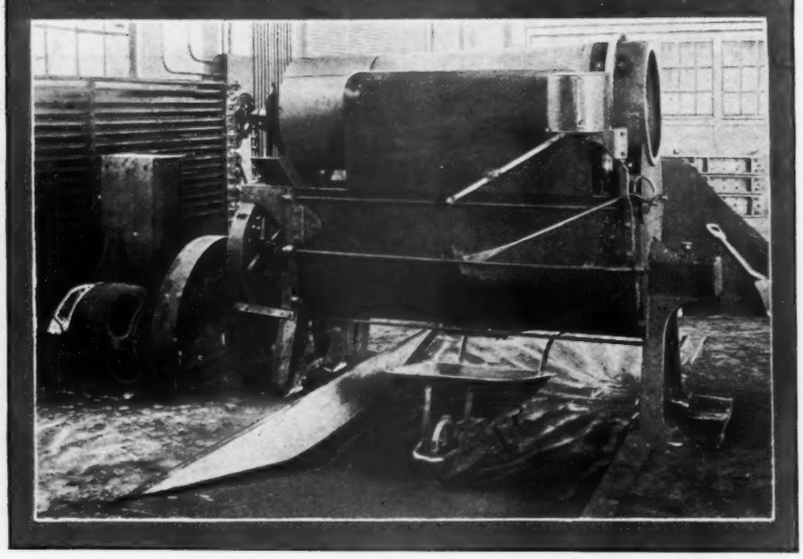


FIG. 3—THE CHARGING FLOOR, SHOWING THE BLOWER CONVENIENTLY LOCATED TO REDUCE THE LENGTH OF THE BLAST PIPE

FIG. 4—THE SAND MIXING MACHINE

FIG. 5—ANOTHER VIEW OF THE SAND MIXING MACHINE, SHOWING THE MOTOR DRIVE WITH GUARDED GEARS

a tract of 15 acres. It has been about 18 years since the National Brake & Electric Co. began the manufacture of air brake equipment for electric railways and about 15 years ago it placed on the market a complete line of motor and belt-driven air compressors for shop and construction work. More recently the scope of the operations of the company has been extended to include the manufacture of gasoline-driven locomotives for general industrial service. Notwithstanding the liberal provisions made for future expansion, the business in all departments has increased so rapidly that the company was recently confronted with the necessity of making extensive additions to its works.

Location of the Plant

The plant of the company is located in northeastern Milwaukee. It is bounded on the east by the main line of the Ashland division of the Chicago & North Western railway, from which the grounds extend west about 500 feet, where the land slopes abruptly and then continues about 350 feet further to the east bank of the river. A beautiful public park lies north of the plant and the land to the south is employed for freight yards. The new gray iron foundry is utilized for the production of a miscellaneous range of castings for the National Brake & Electric Co.'s product and is fitted specially for economically turning out air compressor cylinder castings of various kinds. The work is comparatively light, the maximum output will not exceed 50 tons per day and will probably average in the neighborhood of 35 tons.

The Foundry Building

The rear of the foundry building rests on a concrete retaining wall, which is about 30 feet in height. A basement has been built under the main floor for sand storage and other purposes and an electric elevator is used to convey the sand from the bins to the molding floor. As indicated in Fig. 11, the building consists of a main bay and two wings. One of the latter is used for the production of light, machine-molded castings and the other for making cores. The axis of the molding floor lies north and south and the two wings extend over the sloping ground toward the river. The shop is located south of the open-hearth steel foundry, which was described in THE FOUNDRY, November, 1911, page 89.

The over-all dimensions of the building are 241 feet 10 inches by 239 feet 4 inches. The main molding floor is 241 feet in length and 77½ feet in width. The light work floor at the

south end is 61 x 100 feet. The side bay, east of the molding floor, which contains the cleaning department, cupola room, scrap, coke and iron storage bins, is 38 feet 3 inches in width and extends the full length of the shop. The cleaning room is 38 x 120 feet and the cupola room is 38 x 40 feet. The core room, exclusive of ovens, is 41 x 120 feet. The building is of the usual brick and steel construction on a concrete foundation, with a saw-tooth roof over the molding floor. The second floor over the core room is utilized for pattern storage and a similar floor over the light work wing has been fitted up with lockers and toilet facilities for the workmen. The total molding floor area is 24,700 square feet; the core room area is 4,920 square feet; the cleaning room area is 4,560 square feet and an equal area is occupied by the cupola room and raw material storage bins. Assuming an average output of 35 tons per day, there is approximately 705 square feet of molding floor per ton of daily output. This compares favorably with other shops handling a similar character of work.

The Sand Bins

Four reinforced concrete sand bins are situated under the core room. A plan of this department is shown in Fig. 12 and a view of one of the bins in Fig. 7. Each bin is approximately 27 feet long and 19 feet wide inside, the total capacity being 24 carloads. The bin walls are 9 inches in thickness, reinforced with ½-inch rib bars spaced on 18-inch centers. The total height of the bins is 15 feet. The core room floor is of reinforced concrete, built on the mushroom system, supported by heavy columns, as shown in Fig. 12. A track extends alongside the building over the sand bins, which are provided with chutes so that the material may be discharged directly from the cars. The passageway in front of the bins is 8 feet wide and the doors opening into each bin are 5 feet in width. An electric elevator enclosed in a fireproof compartment and provided with a platform 9 feet square is utilized to carry the sand in buggies from the bin floor level to the molding floor.

Core Sand Storage

The core sand, which is stored in one of the bins, is mixed by mechanical riddlers on the bin floor level before being delivered to the shop. The molding sand, however, is mixed in the molding room in a machine situated alongside the elevator, as shown in Fig. 11. This mixer was furnished by the Standard Sand & Machine Co., Cleveland, and is illustrated in Fig. 5.

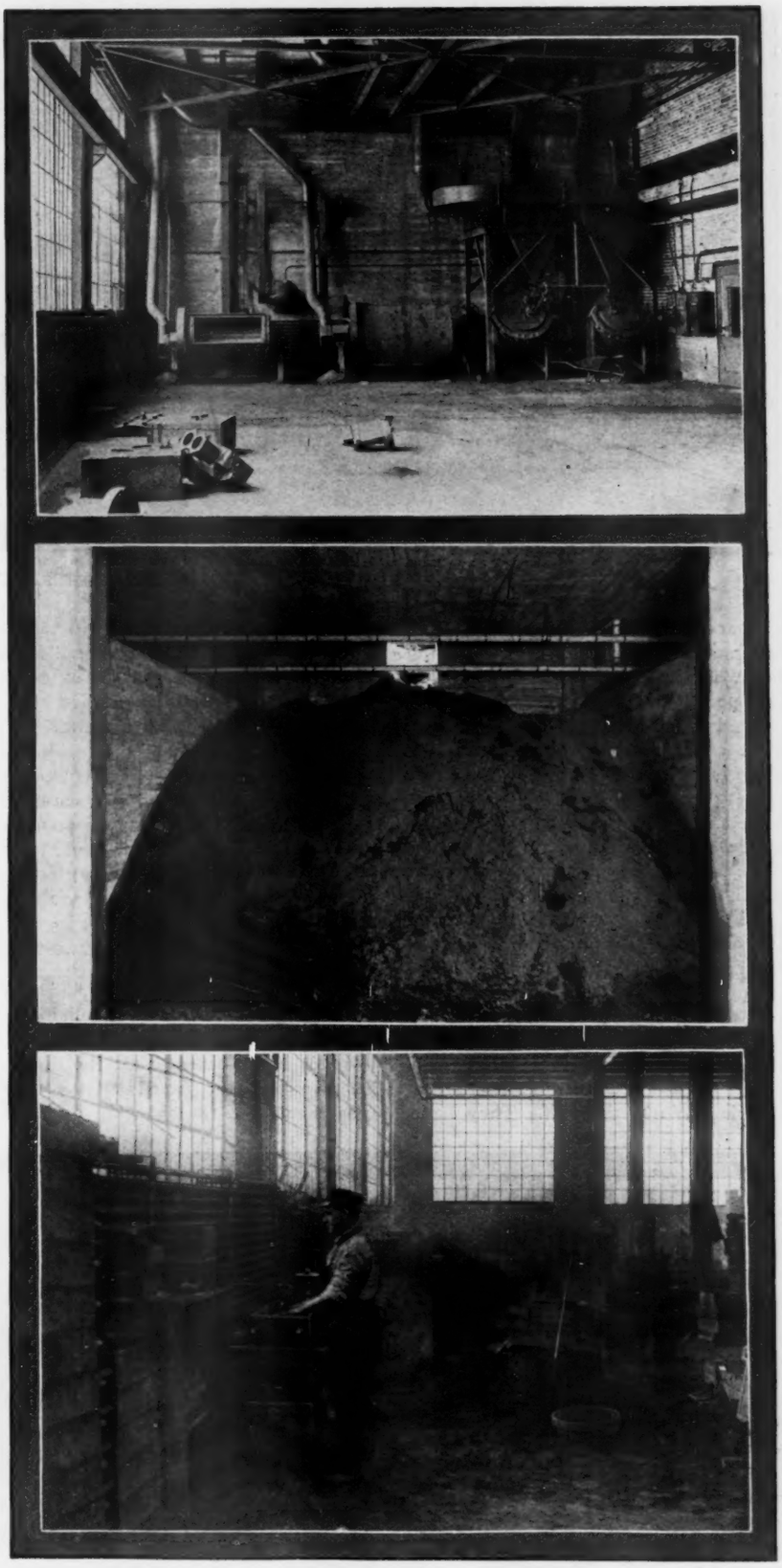


FIG. 6—TUMBLERS AND SAND BLAST BARRELS IN THE CLEANING ROOM. THE MACHINES ARE WELL-ARRANGED TO FACILITATE OPERATIONS

FIG. 7—ONE OF THE CONCRETE SAND BINS SHOWING THE CHUTE THROUGH WHICH THE SAND IS DISCHARGED FROM THE CARS

FIG. 8—BENCH MOLDING DEPARTMENT

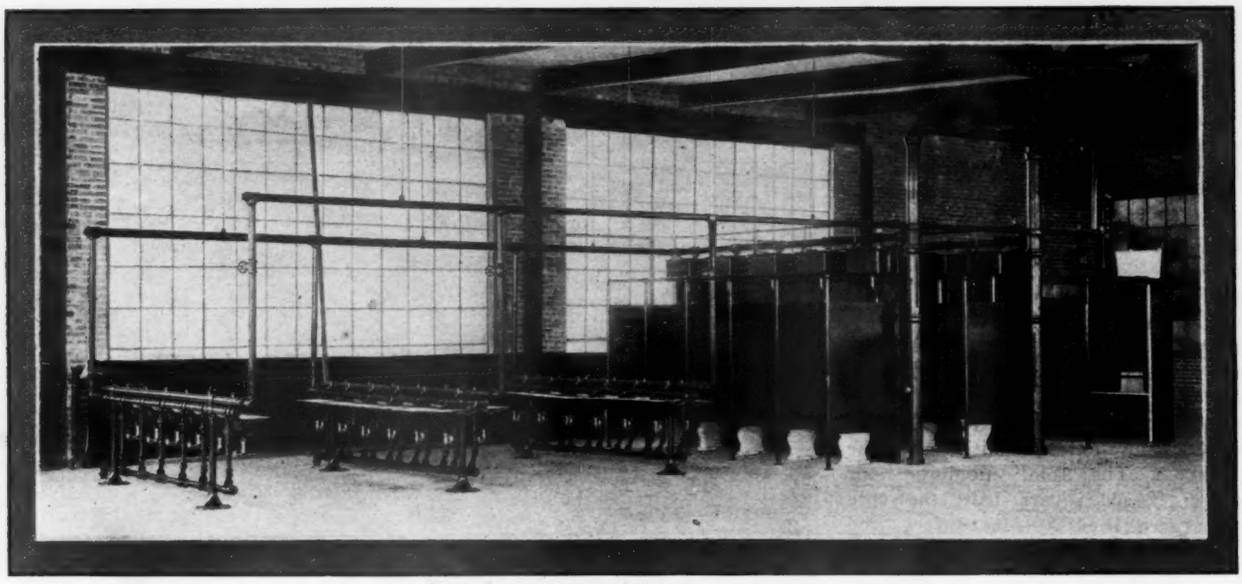


FIG. 9—WASH ROOM AND TOILET FACILITIES

A concrete-lined depression has been built under the machine for receiving the wheelbarrows or sand buggies. This permits the rotating screen to be lowered to a point where a man can fill it easily. After being mixed, the sand is distributed throughout the molding room in wheelbarrows or buckets. The latter may be handled by the traveling crane.

The molding floor is served by a 10-ton, 76-foot span Cleveland electric traveling crane, equipped with a 5-ton auxiliary hoist. The crane rails are 27 feet above the floor and the total height of the molding room from the floor to the bottom chord of the roof trusses is 33½ feet. The main crane is supplemented by two traveling wall cranes, furnished by the Northern Engineering Works, Detroit. They have a capacity of 5 tons each with a 20-foot overhang. The hot metal from the cupolas is handled both in crane ladles of one, three and five tons capacity and in car ladles running on a narrow gage track, as shown in Fig. 1. The light work department is equipped with two Tabor pneumatic squeezers and a Herman pneumatic jarring machine with a 5-foot table is installed in the main molding room. The latter is utilized for molding compressor cylinders.

The Cupolas

The melting equipment includes a Whiting cupola, 42 inches in diameter inside the lining, and a Calumet cupola, 54 inches in diameter inside the lining. The cupolas are placed at the two outer corners of the charging floor, as shown in Fig. 1, leaving plenty of space behind for the elevator, cinder mill and blast piping. The charging floor is 38 x 40 feet, of reinforced concrete, supported by steel beams. It is reached by a 3-ton electric elevator, enclosed in a fireproof shaft and also by a circular iron stairway. The air blast for the two cupolas is furnished by a single Roots positive pressure blower, direct-connected to a 30-horsepower, 230-volt, Westinghouse motor, which runs 750 revolutions per minute. A foundry type, automatically-controlled air compressor, built by the National Brake & Electric Co. is also installed on the charging floor. It has a piston displacement of 225 cubic feet per minute at 90 pounds pressure. The cylinders are 11 inches in diameter with an 11⅛-inch stroke. The

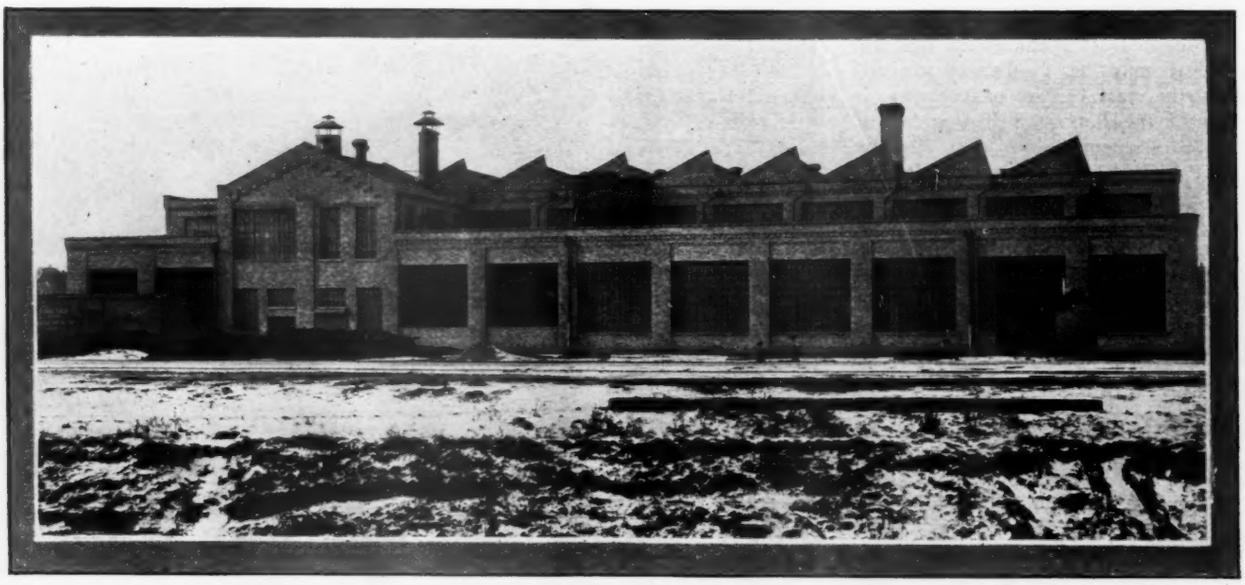


FIG. 10—EAST ELEVATION OF FOUNDRY, SHOWING THE SCRAP AND COKE BINS

machine runs 122 revolutions per minute and absorbs 40 horsepower at 90 pounds pressure. It has three vertical cylinders and is direct-connected to the motor. It is specially balanced so that it runs without vibration. A second compressor of the same type will be installed in the near future.

The coke and scrap are stored in fireproof reinforced concrete bins, located alongside the cupolas, as shown in Fig. 11. The two coke bins are each 16 x 38 feet and are equipped with intercommunicating doors. The scrap bin is 38 feet square. A track runs alongside the bins so that the raw material may be unloaded without any unnecessary labor. These bins keep the coke and scrap under cover, where they are protected from the weather. The iron in the cupola drop is recovered with a Sly cinder mill, located alongside the charging floor elevator.

The core room is 41 feet wide and 120 feet long, divided into two longitudinal bays. The south bay, nearest the ovens, is served by a 5-ton electric traveling crane furnished by the Northern Engineering Works, Detroit. The benches are arranged around the north and west walls of the room, where there is an abundance of natural light. The oven layout is clearly shown in Fig. 11. There are two car ovens, each 15 feet wide and 29 feet 9½ inches long, and four shelf ovens. The large ovens have central flues and are fired from the flask yard in the rear. The shelf ovens are fired from the boiler room on the floor below. Ordinary stock coke and coke recovered from the cupola drop is burned in the core ovens.

The cleaning room is unusually light and in addition to numerous compressed air outlets, it is provided with two Sly tumblers and two Sly automatic sand blast barrels, Fig. 6. The cleaning department connects directly with the molding floor and is served by a 5-ton Northern traveling crane with a span of 38 feet.

The molding floor is lighted by quartz mercury lamps, spaced on 60-

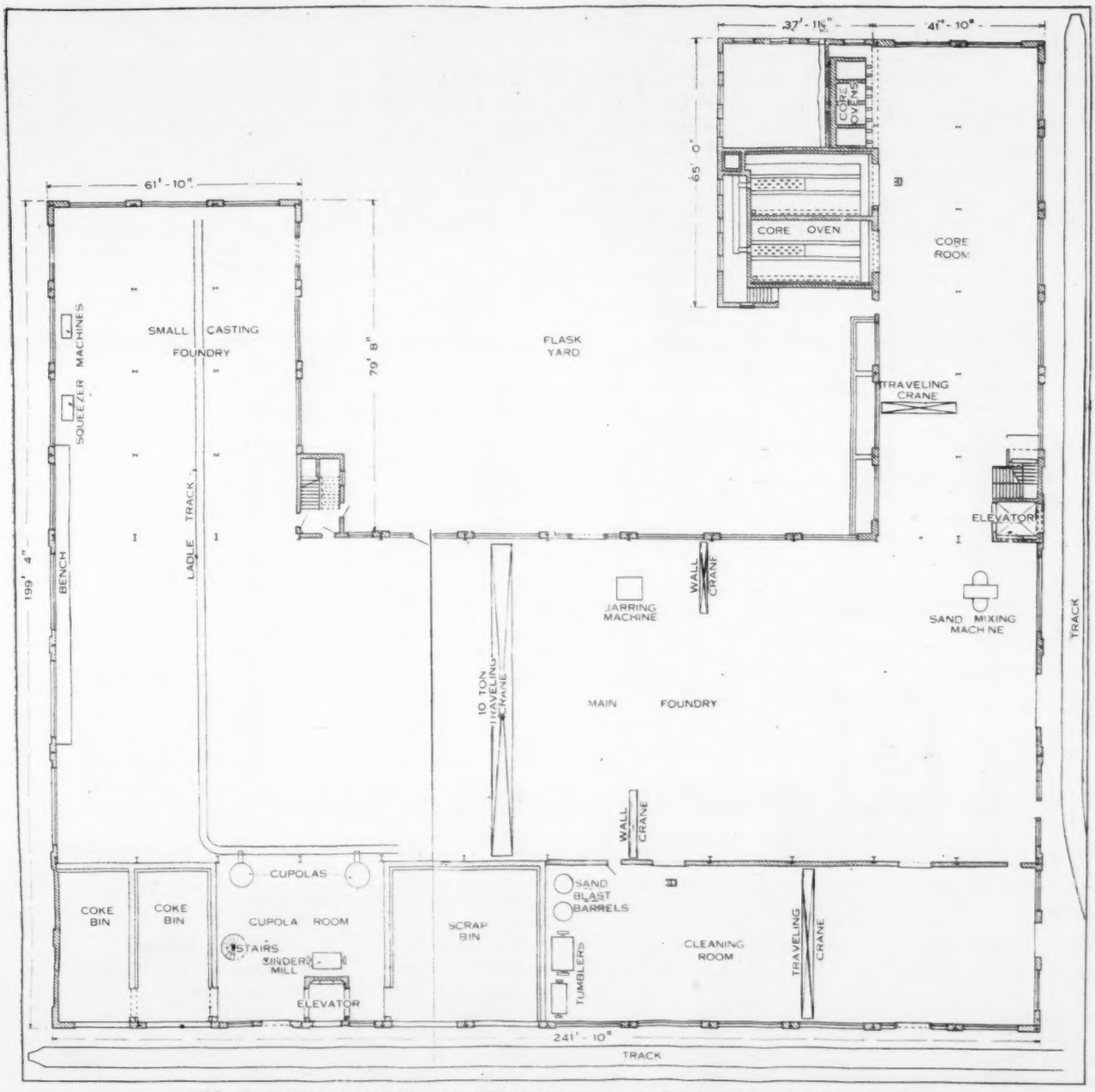


FIG. 11—GENERAL LAYOUT OF THE NATIONAL BRAKE & ELECTRIC CO.'S FOUNDRY

foot centers, and the other departments are lighted with mercury vapor lamps. The toilet and locker rooms on the second floor of the south wing are equipped in a modern and sanitary manner, including individual wash basins with hot and cold running water.

Two Milwaukee return tubular boilers situated in the basement behind the core ovens supply steam to radiation coils, located throughout the shop. Coal for the boilers is stored in a bin situated alongside the sand storage bins.

Open-Hearth Foundry Extension

In addition to the new gray iron foundry, the National Brake & Electric Co. is now completing an important extension to its open-hearth steel foundry. This includes additional molding floor area, 81 x 274 feet, and a flask room, 60 x 274 feet. Six new car type core ovens are also being constructed together with three reinforced concrete sand bins. The overall dimensions of the core ovens are 27 feet 3 inches by 59 feet 7 inches. The new sand bins will be 24 feet 8 inches in length, and 11, 13 and 19 feet in width, respectively. Herman J. Esser, of Milwaukee, was the architect for the improvements described in this article, which were erected under the general supervision of R. P. Tell, general manager of the National Brake & Electric Co.

Rusting of Cooking Range Tops

By W. J. Keep

Question:—We are experiencing some difficulty with the scaling of cooking range tops. When the stoves are shipped from the factory the surfaces of the tops are satisfactory, but after having been in use for several years the tops scale and become pitted. This difficulty is limited almost entirely to cooking ranges.

Answer:—This scaling is caused by salt. When cooking salt meats this rust is particularly noticeable in a circular space around the pot or pan on the stove. The writer is a maker of stoves and occasionally stoves shipped by water on the great lakes have scaled after being in use only a short time. While the reason given above did not apply in this case, nevertheless we found upon investigation that bags of salt had been piled on top of the ranges and caused the scaling. Occasionally when making shipments of ranges to the sea coast we experience some difficulty from rusting, which is attributed to the salt air. In England, from which this inquiry was received, it is not altogether improbable that the salt air is causing the scaling referred to. It is not the practice in America to polish the tops of ranges with emery wheels, although this method is pursued in England. As soon as the natural skin of a casting is removed it will rust much more easily than if the casting is merely polished with blacking, although some grades of the latter contain ingredients which atttack the iron the same as salt. If the salt has been permitted to permeate the iron, it is almost impossible to stop the scaling and in time it will cut through the casting. If a range is properly cared for, this scaling will not result and the fact that only occasionally reports are received of this scaling indicates that it is caused by local conditions or careless use. To further localize the difficulty, it might be well to ascertain whether the scaled portion of the stove is on the fixed top or on the covers. The latter usually are covered by the cooking utensils and are not subjected to the salt.

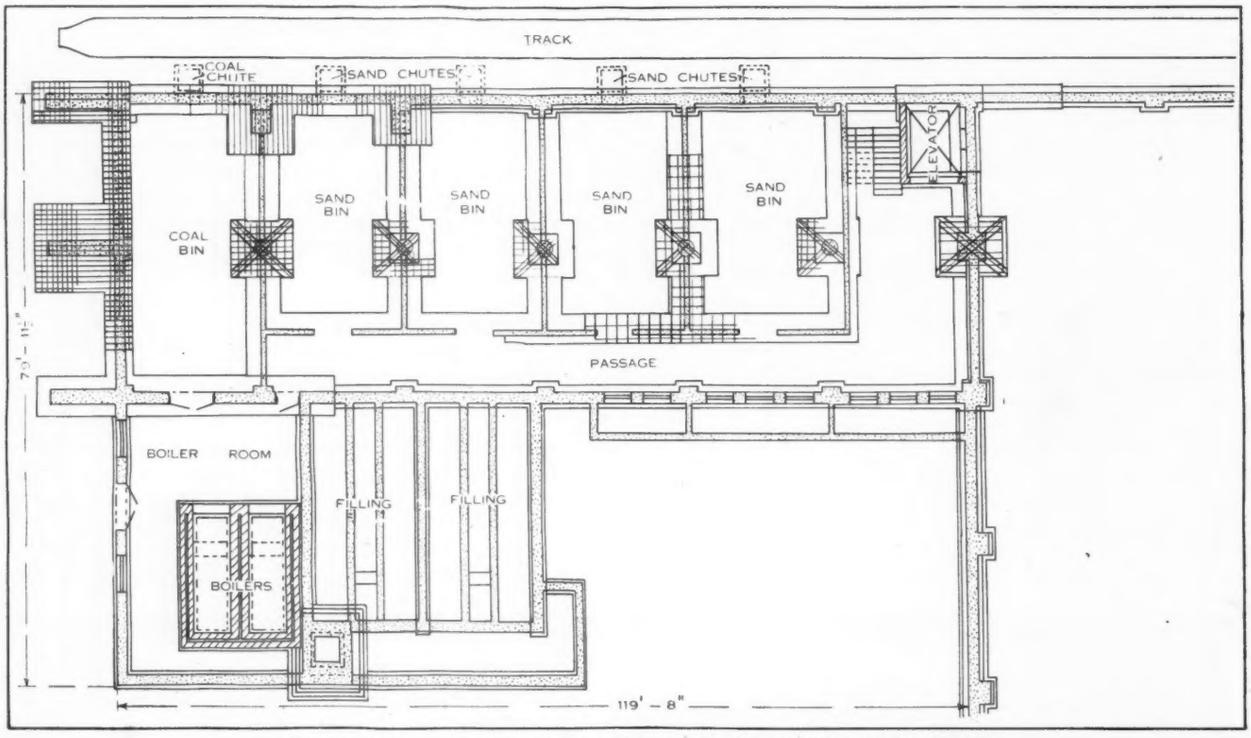
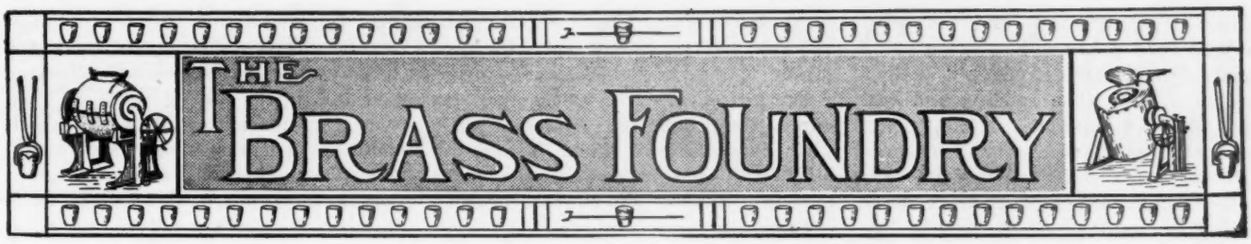


FIG. 12—PLAN OF THE SAND BINS UNDERNEATH THE CORE ROOM

Book Review

Investigation of the Physical Properties of Cast Iron, by C. Jungst; 203 pages, published by *Stahl und Eisen,* Dusseldorf, Germany, and furnished by THE FOUNDRY, Cleveland, for $3.75 post paid.

This German work is a compilation of 6,301 tests of cast iron covering a thorough investigation of its physical properties. These tests were made in a large number of German plants and represent German practice generally. Foundry investigators will find this work of considerable value, as it has been carried out to a large extent along original lines.



Suggestions for Making Aluminum Castings

AT a meeting of the Detroit Foundrymen's Association, held Jan. 8, J. W. Collins, superintendent of No. 1 Detroit plant of the Aluminum Castings Co., presented an interesting paper, entitled "A Few Suggestions on Making Aluminum Castings". His remarks applied particularly to the production of such sections as automobile crank cases, oil pans and transmission cases from the No. 12 alloy which consists of 92 per cent aluminum and 8 per cent copper. Mr. Collins said that the sand used for this work should be very fine and should contain only a small amount of clay.

Sands high in clay will cause endless trouble from blows over projecting green sand cores, even when venting and skin-drying are resorted to. The sand also should be worked as dry as possible and still have it hang in the mold.

In wetting-down the sand after shaking-out the molds, great care must be exercised to prevent getting the sand too wet, as this fine sand does not absorb water readily. The general tendency is to get too much water and not enough *shovel*. Wet sand in the mold invariably means a bad casting.

Use of Chills

Chills are used to bring about uniform cooling of a heavy section or boss, and a lighter section adjoining. They may be made of iron, brass or aluminum, and should be made quite heavy to prevent breakage in removal from the castings and warping from the heat in continual use.

Aluminum chills have the advantage over iron or brass when used in copes on account of their lightness, as they are less liable to fall out; however, regardless of the kind of chill used, they should have annealed nails cast into them, or projections cast on them, to assist in holding them in the sand.

Stock chills, or chills of standard form, that may be used on a variety of jobs, are best made of iron, and for use in the drag of a mold where there is no danger of falling out, may be made heavy, from 1½ to 2 inches in thickness. One thick chill often will replace two or three thinner chills and will make a better looking casting.

Chills that are hot should not be used as they dry out the sand around them, making a rough casting. Chills that have frost in them should not be used, as they will blow from the moisture that will condense on them in the mold.

Ramming the Molds

In ramming the molds for aluminum castings, great care should be exercised to prevent ramming them too hard, thereby closing the pores of the sand. As aluminum is a light metal, being about 40 per cent the weight of iron, it lacks the power to force the gas and steam back through the sand. Molds that are rammed too hard will often produce a casting with a depression at some heavy section, resembling a shrink, when in reality it is caused by the pressure of gas exerted on the metal while it is still molten.

Hard ramming also is the cause of cracks in castings. This occurs, in some cases, where the design of the casting makes it necessary to crush a large body of green sand in contracting. However, light ramming can be carried to the point only where a casting will strain and become overweight. This is an important factor when it is considered that two or three pounds additional weight may result in an increased cost of a dollar to the customer.

In deciding on the best place to gate a casting, three factors are to be considered. First, the metal should be spread throughout the mold so that the casting may be poured fairly cold without danger of mis-running; second, the metal should enter the mold away from heavy bosses and ribs, and third, the gates should be located so that they may be removed easily by a band saw or chipping hammer. Some gates, however, may be broken off by a hand hammer where they are placed in a straight line; for example, along the flange of a lower half crank case or oil pan; but provision must first be made by casting a small groove in one side of the gate where it adjoins the casting. Horn gates are recommended, wherever they can be used, as they allow the metal to enter the mold with the least disturbance.

The sprue and leader should be made heavy, so as not to freeze before the casting. Generous fillets also should be employed where the gate adjoins the casting.

Risers should be used plentifully, as they give an added pressure and assist in making a sound casting. The removal of the risers also should be considered when placing them on the pattern, so that they do not break into the casting or draw the metal away from the casting in cooling. A good head pressure to carry on all sprues and risers is from 6 to 12 inches, depending on the thickness of the uppermost part of the casting.

Mold Inspection

All molds should be carefully inspected by the molder as soon as the pattern is drawn, to see that the core prints are rammed sufficiently hard to support the cores and to see that the mold in general is rammed to the correct consistency to produce a good casting. The molder also should be certain that all necessary chills have been used and are correctly placed. This is an important feature when it is considered that the absence of one chill, or the misplacing of another, may mean the loss of a casting.

This inspection applies more particularly to machine gangs, where the cope and drag are made by different men or teams of men, the molder finishing the molds and setting the cores.

In the general run of foundry work at least three core sand mixtures are necessary, the oil sand mixture for the small and intricate cores and two mixtures containing resin, flour or compound for the larger cores. One of the two latter mixtures is made about 50 per cent stronger than the other. The weaker mixture is used for the

general run of cores, and the other is employed when, on account of a core's design, extra strength is needed, and then only when rodding and wiring will not answer. The stronger mixture also is used when the drag half only of a complete core is made in dry sand, the cope half being made with green molding sand. In the latter case, the entire weight is carried by the dry sand core. However, none of the mixtures should be stronger than is necessary to make a core that can be handled and placed safely in the mold.

Soft cores are necessary for the following reasons: There is not enough heat in the molten aluminum to burn up the core, thereby softening it; aluminum is a weak metal at the point of solidification and has very little crushing strength just prior to solidifying. Cores that are too hard will cause the casting to crack. Hard cores also will cause trouble in removing them from the castings, as the cores are seldom burned to a greater depth than ½ to ¾ inch.

Chills in Cores

Chills are used in the cores on heavy bosses and at the intersection of ribs, the same as in the molds. If there is any danger of the chills falling out of the core while it is green or after it is dry and placed in the mold, they should have nails cast in them, or projections cast on, to anchor them firmly in the core. Applying paste to the chills will also assist in holding them in place. In designing chills and in deciding where to place them to remedy a crack or draw in a casting, one thing must be remembered, and that is the chill must come out of the casting easily.

A great many rods and wires are necessary to strengthen and support cores for aluminum castings. This is due to the weak sand mixtures used. The rods should be as short as possible and, if a long core has metal around each end, the rods should be used in short, overlapping length. Straight rods are preferred to crooked or bent rods, unless they are bent to conform to the core box as the latter resists the crushing of the core by the casting when contracting. The ends of rods should never be placed close to the sides or ends of a core box except into core prints, as they will sometimes cause the casting to crack, or even force themselves through the casting.

It is necessary to handle nearly all of the larger cores with hooks, as they are broken easily if placed in the mold with the hands or straps used under them. These hooks should be firmly anchored in the core and placed so that the core will balance when picked up.

To get a smooth surface on the cores, they must be treated with a wash of some kind. This is best applied with a spray, while the cores are green, and afterwards brushed over with a camel hair brush and clear water. The brush and water also can be used to clean off the chills which lose their effect if covered with a coating of core wash. The core wash also serves to give the core a hard crust on the outside, which helps to prevent breakage of corners when handling.

Baking Cores

The baking of the cores is an important item and should be done with a slow, steady fire and under pyrometer control. If care is not exercised, the corners and edges will be burned before the center of the core is dry. Resin sand cores should never be handled while hot as they are easily broken.

After the cores have been removed from the ovens, they should be thoroughly cleaned and inspected to see that all excess core wash has been removed from the ribs and bosses. The location of all small cores that have been pasted into the main core also should be checked with a suitable gage.

In melting, aluminum should never be heated to a temperature higher than is necessary to pour the castings, allowing for a drop in temperature in dipping and transferring to the pots in which it is carried to molding floor. A temperature of 1,500 degrees Fahr. will usually take care of this. As soon as the metal is hot enough, it should be thoroughly stirred and skimmed, then dipped out and carried to the molds. The metal in the furnaces should be under pyrometer control and also should be kept covered during melting.

In dipping the metal from the furnaces, if iron melting pots are used, care should be exercised to prevent scraping the sides of the pots. Hard spots in castings are sometimes attributed to the metal that clings to the sides of the melting pots. To avoid this, the sides of the pots should be scraped clean two or three times a day.

To prevent over-heating the metal and to get it to the floor hot enough to pour, arrangements should be made to preheat the dipping and pouring ladles.

The best method of pouring the molds is by a gang specially trained for this work, and a great deal of the molding gang's time is saved by this system. Each jog has a best pouring temperature, which, in nearly all cases, is as low as the casting will run. This, of course, has to be found by experiment. When this has been ascertained, use a pyrometer on every floor and on every pot and the perplexities of mis-run castings will be removed.

New England Foundrymen Elect Officers

At the annual meeting of the New England Foundrymen's Association, held at the Exchange Club, Boston, Wednesday, Jan. 14, officers for the ensuing year were elected as follows: Charles L. Nutter, Old Colony Foundry Co., East Bridgewater, Mass., president; A. F. Corbin, Union Mfg. Co., New Britain, Conn., vice president; George H. Gibby, Gibby Foundry Co., East Boston, Mass., treasurer, and Fred F. Stockwell, Barbour, Stockwell Co., Cambridge, Mass., secretary. The following members of the executive committee also were elected: Charles A. Reed, Reed, Fears & Miller, Boston, Mass.; J. C. Hosford, Magee Furnace Co., Chelsea, Mass.; D. K. Bartlett, Builders' Iron Foundry Co., Providence, R. I.; W. B. Leach, Hunt-Spiller Mfg. Co., Boston, Mass., and L. J. Harley Co., Springfield, Mass.

Describes Manufacture of Carborundum

At the monthly meeting of the Chicago Foundrymen's Club, held at the Sherman hotel, Chicago, Saturday evening, Jan. 10, C. C. Schumaker, Chicago manager of the Carborundum Co., gave an illustrated lecture on the manufacture of grinding wheels. The meeting was preceded by a dinner at the College Inn. Mr. Schumaker's lantern slides were made from photographs taken at the Niagara Falls plant of the Carborundum Co. and illustrated very completely the modern electric furnace method of making grinding wheels from a compound of silica, coke, sawdust and salt.

Charles Willmott, Smethwick, Eng., has invented and patented an aluminum solder which contains tin, 86 per cent, and bismuth, 14 per cent. A blowpipe is employed and the metal on the surface of the aluminum is scraped to facilitate the adherence of the solder.

The Moser Pattern Works, Newark, O., has been established by F. W. Moser to specialize in the manufacture of aluminum match-plates and all classes of metal pattern work.

Approximate Melting Points of Copper Alloys*

Results of an Investigation to Ascertain the Melting Temperatures of Some Commercial Mixtures, With Details of Tests

By H W Gillett and A B Norton

IN THE course of investigations of brass melting furnaces it was necessary to determine the approximate melting points of a few of the common brasses and bronzes. The binary systems of copper-tin and copper-zinc alloys have been thoroughly worked out not only as to melting points, but as to the full phase rule relationships, showing the different phases present in the solid alloys at different temperatures, and also as to tensile strength. The United States alloys research board, under Thurston, studied the mechanical properties of the ternary systems of copper-zinc-tin alloys in detail, but as pyrometers were not perfected at the time of that investigation the temperature measurements were confined to very crude ones on the pouring temperatures of the two binary, copper-tin and copper-zinc, systems, made by pouring the molten alloy into water, measuring the rise in temperature of the water and figuring the pouring temperature from the assumed specific heat of the alloy. The method, though the only one available at the time, was so crude and subject to so many errors that the figures are of little or no value. Experiments on the copper-zinc-tin system from the phase rule point of view are in progress at Cornell University, but no melting-point determinations have yet been made.

Thus, while the melting points of the two binary systems are well known, those of the commercial casting alloys containing copper, zinc, tin and lead, or copper with two of the other components, have had little or no study.

Lack of Data on Melting Points

Very few figures on the melting points of ternary and quarternary alloys can be found in the literature on alloys. Primrose mentions pouring gun-metal consisting of 88 parts copper, 10 parts tin and 2 parts zinc, at 950 degrees Cent. (1,740 degrees Fahr.), this temperature being far too cold and giving a very poor casting of very low tensile strength, hence evidently not far above the melting point.

This figure is probably not correct, as an alloy consisting of 90 parts copper to 10 of tin has a melting point of about 1,005 degrees Cent. (1,840 Fahr.) and 2 parts of zinc would probably not lower the melting point to such a degree.

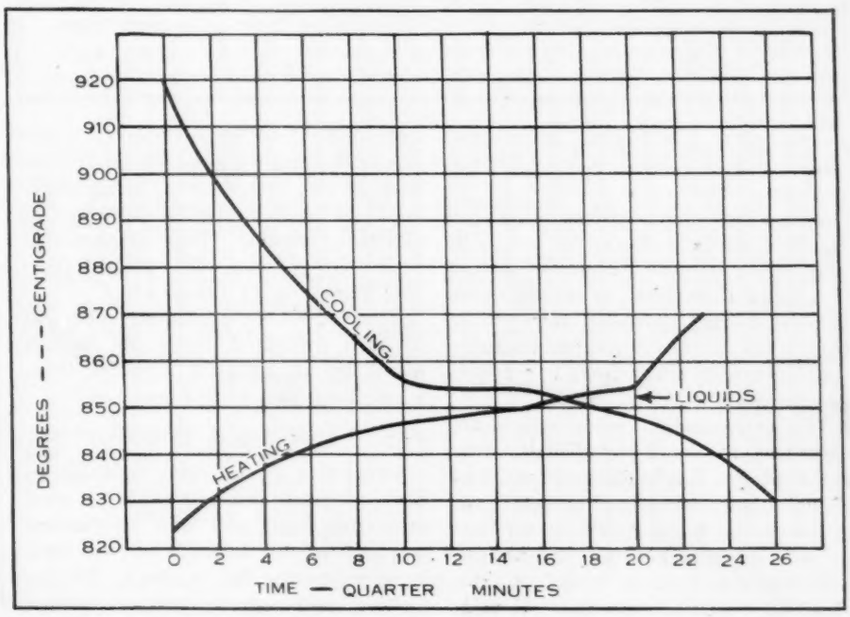
Primrose in a later paper shows a cooling curve for gun-metal containing 88 per cent of copper, 10 of tin and 2 of zinc, with less than 0.2 per cent of lead (exact analysis not given), which shows the melting point (liquidus) at 1,010 degrees Cent., or slightly above that for a corresponding zinc-free bronze, although some lowering of the melting point by the zinc might be expected.

Longmuir also poured some alloys at a temperature at which the metal would just flow, and so cold that in all cases the castings were poor and the tensile strength very low. The results obtained by Longmuir were as follows:

Alloys.	Degrees, Cent.	Degrees, Fahr.
Gun metal	965	1,770
Yellow brass	850	1,560
Red brass	1,058	1,935
Muntz metal	943	1,730

These figures also are probably not accurate. The remark made on the earlier figure by Primrose for gun metal applies here. The composition of the alloys was not given. If it be assumed that the names given have their normal significance the yellow brass would be about 65 parts copper and 35 parts zinc, an alloy which melts at about 915 degrees Cent. (1,680 Fahr.), and the Muntz metal would contain 60 parts copper and 40 parts zinc, an alloy which melts at about 890 degrees Cent. (1,635 Fahr.). Muntz metal has a lower melting point than yellow brass, not higher, as shown by these figures. Similarly, red brass of the common composition, which is about 85 parts copper, 5 tin, 5 zinc and 5 lead, has a lower melting point than gun metal (taken as 88 parts copper, 10 of tin and 2 of zinc).

Karr used a radiation pyrometer in determining the melting points and pouring temperatures of some copper alloys. For an alloy of 68.8 parts copper, 0.2 of lead and 31 of zinc, he gives 1,640 degrees Fahr. (895 Cent.), which is considerably lower than the true melting point, evidently because



MELTING POINT CURVES FOR NAVAL BRASS CONSISTING OF 61.7 PER CENT COPPER, 36.9 PER CENT ZINC AND 1.4 PER CENT TIN

*Presented at the Chicago meeting of the American Institute of Metals.

of the well known deviation from black-body conditions of molten copper or its alloys. He gives 1,650 degrees Fahr. (900 Cent.) as the melting point of one alloy containing 84 per cent copper, 1,735 degrees Fahr. (945 Cent.) for that of another of the same copper content, and 1,850 degrees Fahr. (1,010 Cent.) for another said to correspond to gun metal, but containing no zinc.

Since the literature on the subject was found to be so meager, it was decided to obtain figures on the melting points of a few typical commercial alloys with sufficient accuracy for the purpose in hand.

Table I.

RESULTS OF MELTING POINT DETERMINATIONS OF 10 ALLOYS.

Alloys.	Composition Aimed at Per cent. Copper.	Zinc.	Tin.	Lead.	Composition by Analysis. Cop'r.	Zinc.	Tin.	Lead.	No. of duplicate determinations.	Melting point (Liquidus). Cent.	Fahr.
Gun metal	88	2	10	.	....	....	...	...	4	995	1,825
Leaded gun metal....	85½	2	9½	3	85.4	1.9	9.7	3.0	6	980	1,795
Red brass	85	5	5	5	....	....	*	*	8	970	1,780
Low grade red brass.	82	10	3	5	81.5	10.4	3.1	5.0	4	980	1,795
Leaded bronze	80	..	..	10	....	....	...	...	3	945	1,735
Bronze with zinc....	85	5	10	.	84.6	5.0	10.4	...	4	980	1,795
Half yellow, half red.	75	20	2	3	75.0	20.0	2.0	3.0	3	920	1,690
Cast yellow brass....	67	31	..	2	66.9	30.8	...	2.3	4	895	1,645
Naval brass	61½	37	1½	.	61.7	36.9	1.4	...	5	885	1,570
Manganese bronze ...	..	..	..	.	....	....	...	...	6	870	1,600

*(2 samples)

The alloys were melted in a gas furnace. Instead of using the ordinary shape of crucible which exposes too large a surface to volatilization and oxidation, crucibles were made from some bonded carborundum tubes which were in stock from a previous investigation.

The carborundum tubes which are described in detail by Gillett were about 4.5 cm. inside diameter and had about 8 mm. walls. They were cut to about 15 cm. long and an artificial graphite plug was fitted at one end to form the bottom, luting it into place with alundum cement. Considering the cost of machining out a crucible from a graphite rod, as well as that of the graphite itself, these were much cheaper than artificial graphite crucibles, especially as they do not burn away anywhere near as fast as graphite. Their life was as long as that of the ordinary crucibles of fire clay and graphite mixtures. The temperatures were measured by a platinum, platinum-rhodium thermocouple used with a single pivot galvanometer.

The couple was calibrated against one which in turn had been checked against one calibrated by the bureau of standards, the secondary standard being read on a potentiometer, and the scale found to be correct within the limits of error of reading. The calibration was also checked up by reading the melting points of copper, of common salt and of a bronze of 90 parts copper and 10 parts tin. The scale was correct within the error of reading at these points.

The thermocouple wires were insulated by Marquardt tubing of 1 mm. bore and 2 mm. in outside diameter, and the hot junction was slipped into a Marquardt tube 30 cm. long and 9 mm. outside diameter and 5 mm. inside diameter closed at one end. The open end of this tube was fastened into an open-ended porcelain tube 35 cm. long, 10 mm. inside diameter, 14 mm. outside diameter by alundum cement. This arrangement served to protect the couple from zinc fumes or reducing gases.

The end of the protecting tube was in turn protected from the molten metal by an artificial graphite boot, 9 cm. long and with 3 mm. walls.

Time Lag in Reading

There is a considerable time lag in the pyrometer reading when a cold protecting tube and boot is plunged into molten metal, but after the tube is once hot the lag is small. As the melting points were not determined by noting when the metal solidified, but by plotting temperatures against time, the proper temperatures for the heat evolution on freezing or heat absorption on melting should be shown even if there was some lag.

About 600 grams of metal was used in making the tests, the metals were weighed out in the proper portions to form the alloy desired, a slight excess of zinc, increasing with the increasing zinc content, being allowed to compensate for volatilization. Electrolytic copper, Bertha zinc and chemically pure lead and tin were used. The copper was melted first and covered with granular carbon and a little salt. When the copper was melted, the tin, the lead and lastly the zinc was added, and the alloy well stirred with a graphite rod.

When the alloy was fully melted and mixed, the pyrometer was inserted and so clamped that the graphite boot did not touch the bottom or sides of the crucible. The gas flame was lowered and the temperature read every 15 seconds, stirring between each reading. When the alloy had frozen the gas was turned up and a heating curve taken. This was repeated several times. Zinc was continually volatilized from the melts containing zinc, but not in sufficient quantity to exert appreciable influence on the melting point, as duplicate runs agreed within 5 degrees Cent. in all cases. After the runs were completed, the melt was poured in most cases into an ingot mold, sampled and analyzed. As the analyses agreed well with the composition aimed at on the samples analyzed, the melts not containing zinc were not analyzed. Duplicate analyses of the same sample agreed within 0.1 per cent.

All the melts were made up from virgin metals except the sample of manganese bronze, which was in the form of test bar ends from a previous investigation. It had tested 76,000 to 77,000 pounds per square inch tensile strength and 24 to 35 per cent elongation in the standard brick-form test bar. The bronze had approximately the following composition: Copper, 56 per cent; zinc, 41 per cent; iron, 1.5 per cent; tin, 0.9 per cent; aluminum, 0.45 per cent, and manganese, 0.15 per cent.

Table II.

MELTING POINTS OF THREE BINARY ALLOYS.

Copper-Tin Alloy

Parts by Copper.	Weight Tin.	Melting Point. Cent.	Fahr.
95	5	1,050	1,920
90	10	1,005	1,840
85	15	960	1,760
80	20	890	1,635

Copper-Zinc Alloy

Copper.	Zinc.	Cent.	Fahr.
95	5	1,070	1,960
90	10	1,055	1,930
85	15	1,025	1,880
80	20	1,000	1,830
75	25	980	1,795
70	30	940	1,725
65	35	915	1,660
60	40	890	1,635

Copper-Lead Alloys

Copper.	Lead.	Cent.	Fahr.
95	5	1,065	1,950
90	10	1,050	1,920
85	15	1,035	1,895

As it was first cast into an ingot, then remelted and cast into test bars and these again remelted for melting-point determination, the zinc content was probably nearer 40 than 41 per cent and the copper nearer 57 than 56 per cent when the melting points

were taken. This sample was not analyzed.

The melting point given is the liquidus, or point given where freezing begins on cooling and ends on heating. This is more strongly marked than the solidus, or point where freezing ends on cooling or begins on heating. The accompanying illustration shows one set of curves and the characteristic break at the melting point. These curves are typical of all melting point determinations.

The data obtained in the determination of the melting points of several alloys are given in Table I.

As the results all checked within 5 degrees Cent., an allowance of ± 10 degrees Cent. or ± 20 degrees Fahr. is probably ample to cover all errors of reading and of calibration and use of the pyrometer.

Melting Points of Binary Metals

For comparison the melting point (liquidus) figures for binary systems of copper-tin, copper-zinc and copper-lead alloys for the range covering the common industrial alloys are given in Table II. These are scaled off from curves in the references given. As the curves are small, the figures are only accurate to within about ± 10 degrees Cent. or ± 20 degrees Fahr.

Although melting point determinations were made on only 11 alloys, those chosen represent a large proportion of the non-ferrous alloys in use in the ordinary foundry. Many of the other common alloys are near enough in composition to these or to the binary alloys, whose melting points are given, to allow obtaining the melting point by interpolation close enough for most technical purposes.

The Brass Foundry of the Future*

By C P Karr†

THE brass foundry of the future cannot be forecast with any degree of certainty without considering the status of the foundry as it is today and of making comparisons that are more or less indictments of present-day practices. In every large foundry where from one or more gates of similar patterns many castings are made, the tendency is to reproduce the product on a large scale. Match plates, plastic molds and various other devices are made use of to economize the cost of labor, to expedite the production, to insure avoidance of waste and to lessen unnecessary duplication; to this end, cranes and trolley tracks are installed to lift heavy charges and convey them quickly over great floor areas to their pouring destination; to promote their handling at the furnace mouth, lifting cranes, hoists, counterweighted furnace covers and various other devices are used to save time, to avoid loss in cooling and to lessen the hardships endured over hot fires and to eliminate close contact of the melter with his molten metal.

Forced blast is employed to save time in melting and to increase the product per heat per man; to prepare the castings for their journey to the finishing shop, tumbling barrels, sand blast apparatus, gate cutters or circular saws are used to effect a further saving of time and a reduction in the labor cost; everywhere machinery and more machinery of the most ingenious and expensive kind is installed to effect economies of cost and uniformity of production. In some shops, everything is standardized but quality, quantity is supreme. Even the pattern shop in some cases is run on a semi-classified scientific basis to insure uncertainty of selection and procrastination of action. Patterns, that for ages have become shrouded with cobwebs and no longer fit even for a decent burial, are religiously preserved in some forgotten corner of the old style pattern shop; today they may be of some use; tomorrow they will be relegated to the junk heap. Today the whereabouts of a certain pattern, one it may be of 10,000, is known only to the mysterious memory of one man in custody of them, but tomorrow every pattern will be numbered, classified according to its usage or function, have its proper place in the thousand or more pigeon holes or cupboards or racks, be card-indexed so that even the core boy in the shop can instantly place his finger on any pattern that is wanted.

The Core Room

In the core room, the work is often done in a haphazard way, but tomorrow we shall find that the work has become highly specialized, some simple cores that are to be duplicated indefinitely are turned out in great quantities by suitable machines. In the molding department the old-fashioned bench molder who used to lord it over us all with his mysterious wrinkles, kinks and ultra-wise shakes of his owlish head, is fast becoming an interesting figure of the past, even a memory and nothing more, his importance has dwindled to a pitiful insignificance. For the tendency of the day is to adapt every pattern possible to the manipulations of the ubiquitous molding machine. Looking at the progressive foundry of today it would seem as though nothing more could be done by machinery to increase the efficiency of the output, its quality or its productive amount, but even in such a direction the future may have for us many a surprise in store, the development may take the shape of greater automatic action and simplicity. When we have reached such a parting of the ways, where are we to look for further improvement and higher efficiency with better quality of product and lessened cost of production?

The one element of this economical problem which has been studied the least of all in our constant endeavor to advance the art and the science of the foundry to its highest estate is in the one variable human unit of all foundry production, namely, the man behind all this intricate machinery, the dispenser of all these resources. It is difficult to say where we should begin such a consideration of this human unit; perhaps the simplest and most logical procedure would be to begin with the first operation of the molder himself and his choice of materials.

First is his sand, which offers a wide field of research and needs improvement. We have been accustomed to get the best natural molding sand offered in the open market and let it go at that, few of us have taken the pains to question its quality or adaptability to the ends we had in view. We look at the pattern, ascertain its purpose and judging some of us by intuitions, others by a rough rule-of-thumb, we direct the casting to be done in green sand, dry sand or loam, maybe, and pass it up to the molder. Then when failure comes, we are surprised, or claim that we are; if we have a sand that feels too loamy to our touch, we may open it up with a mixture of pure

*Presented at the Chicago meeting of the American Institute of Metals.

†Associate Physicist, Bureau of Standards, Pittsburgh.

quartz sand and give the confined gases a chance to escape, but how much shall we use, when shall we use it, how may we best disseminate the quartz sand through the loam, what is its temperature of vitrification? Few of us know. Experiment and investigation alone will answer such important questions, but if we are to avoid unsuccessful castings and consequent loss of time and labor, such questions must be answered right; the future foundryman will make it his economical business to answer them. Is his sand too dry, or too wet, or has it been properly screened and tempered? At the present time the mighty, but easy rule-of-thumb method prevails; in the future the expert founder will have somebody devise for him a simple cubic measure and balance to inform him as to these things; he will have at his beck and call some simple test which shall tell him at once whether he can go successfully ahead.

Drying Molds

In drying molds today, the lower part of the drying stove has a red hot zone all the way around the lowest section; above, the iron shell is moderately hot, the drying temperatures throughout the vertical sections of the flasks are of variable degrees, and as a result the molds are not uniformly dried out. Therefore, what kind of castings has the molder a right to expect from such means of drying? In the future he will have a drying oven maintained at a regular moderate temperature, a muffle oven, if you will, provided with a self-recording pyrometer, a time clock to regulate the time of exposure and insure a dry-skin over the entire face of the mold, or an electric oven heated to a constant temperature. In bench molding every motion of the molder is governed by the amount of personal skill he possesses; some of these men have a marvelous delicacy of touch and certainty of action and confidence of control; in the future greater skill may not be attained, only a more uniform result. He will become more adept in the use of his sand and perhaps more skillful in his use of cores. If he has to pour his own molds, as today he generally does, the future will bring many changes. His judgment of the pouring heat as now generally practiced will be taken from him because the pyrometer will give him his pouring heat without dispute. His judgment as to how fast or slow, or uniform a charge must be poured will have to be a matter of personal skill and decision based upon past experience just as it is today, but the molder of the future will necessarily be a man of trained mind, ripened by study and observation and his decision as to any course of procedure will be of more value to his employer than that of his fellow-workman of today.

If such a man be a machine molder, he will make himself personally familiar with every lever, nut, bolt, screw, spring, cam and mechanical device of his machine, so that he can see at a glance whether his machine is working up to its best condition, even his ear will be trained to detect a discordant sound in the smoothly gliding noises which his machine might utter if something be awry, and, in addition to this, he will have sufficient natural mechanical skill to take the entire complex mechanism apart and put it together again, if necessary, without the aid of the master machinist of the works. This suggestion may seem like stretching the point of departure from present-day practice a little too far, yet if any one will recall from his own personal experience what he knows of the vast amount of cheap and inexperienced labor that today is operating machines for molding in almost every shop in the land and then look at the product of such labor and count the vast losses thus entailed, the conclusion arrived at may not be so exaggerated as it seems.

Premium System

In the future the premium system applied to the number of good castings produced by the machine molder will establish the point thus made. If the current practice of the shop is to have each molder pour his own work, then in addition to the mechanical qualifications thus stated, the successful molder of the future must in every sense of the word be a man, a man unafraid of personal danger, for every time a man pours a pot of metal into a mold he takes his own life and the lives of the men in his immediate vicinity into his own hands. Many of us have witnessed instances of personal heroism that would make the wildest romancer pale with envy, because the genius had not been vouchsafed to him to conceive of anything so noble and glorious.

As all of us know, the work of the modern foundry has become a matter of specialization to a startling degree. For example, the furnace man is second to the molder only in the order of his connection with the production of a casting, not second to him in order of importance; in fact, it is hard to draw a line between them. Why should we? They co-ordinate each other so as to produce the curve of efficiency, if we may draw an illustration from the art of the metallographer.

Today, as a rule, the furnace man is simply a melter of scraps, a compounder of junk and any old metal that is wheeled up to him. He may have charge of a number of furnaces; these may be fired in various ways—all these furnaces and their devices look alike to him—his one task is to get his charge into the pots as fast as he can, run them down quickly; as soon as the last gate disappears, off comes the lid, up comes the pot, whisked onto the trolley and rushed to the molder, who is waiting to fill his molds, and quite frequently, as some of us know, the pot full of metal is sent indignantly back to him, too cold to pour, too thick, or something wrong about it. In it goes again to be soaked, oxidized by the gases of combustion, burned maybe, and out it comes again, smoking hot and then it is poured. The amount of bad castings produced tells a story that needs no explanation.

Furnace Man of Future

The furnace man of the future will know about every mechanical appliance of his furnace as well, if not better, than its manufacturer, and he will be quick to detect and avert every faulty working. He will know how to regulate his air pressure to his oil or gas supply so that his furnace will at every moment be working at its utmost efficiency; he will know how to hold his heat at almost a constant temperature when such a proceeding becomes necessary. He will become acquainted with the use of various pyrometers, be able to adjust and read them and interpret their results to aid him in the production of a superior metal. He will necessarily have had some chemical education and laboratory practice so that he may be able to flux his metal intelligently. He will also have a practical working knowledge of physical chemistry, know the difference between alpha and beta copper, so that the microstructure of a metal will not be a blank to him; he will have a knowledge of the gases of combustion, know how to determine them so that he may the more skillfully operate his furnace during the melting process. If he works in a very large foundry, it will be incumbent on his employer to place him in the way of obtaining such information either by encouraging him to attend a night school, where he may study the higher art of good foundry practice or conduct a school within the works for those who wish to attend.

To the furnace man of the future the metallurgy of the metals he uses will be neither a sealed book nor a lost art. The subject will possess for him a boundless fascination, the witchery of a tale that is never fully told, because the new art will never

become trite for him and the old will never lose its eternal charm.

In the core room of the future, of course, will be embodied in its chief a fuller knowledge of core sands, a better knowledge of binders, a more complete comprehension of the absorption of gases, the retention of moisture by various sands, the ratio of voids to solids, the variation of specific gravities, a greater knowledge of plasticity, all tending to expand the coremaker's grasp of means to an end, virtually an applied science as well as a versatile art.

And last, but not least, the successful brass foundry of the future will be operated and controlled by a man versed in every correlated department of metallurgy applied to his field of endeavor, for metallurgists then as now will remain a highly specialized class of men, each working to the best of his ability to read the mysterious laws of nature and apply them the most profitably. Metallography, which now to many is nothing more than a mysterious confusion of lines, scratches and crystals, will in the future fall into lines of grace, imprints of a wider science and refulgent with a white light of knowledge. Great work for the foundryman has been done by the metallographer of today, but greater yet is to be done.

Future Foundry Foreman

The foundry foreman of the future will not arrive at his final conclusions with respect to the failure of his castings or be guided in his means of correction solely by tensile, compressive or hardness tests as we now know them, but will demand a series of metallographic tests, or perhaps make use of the spectroscope, dissociation and electrical tests of various sorts before there can be indicated to him the royal road to success. In that future day he will study not only the individual properties of each metal with which he is working, but more completely than we do now, he will ascertain what is the correlative action upon one another in varying proportions and submitted to various temperatures and pressures, melted perhaps under inert atmospheres, he will investigate their chemical action upon one another, also their inter-phase action, their crystallizing forces and catalytic transformations. All of such and kindred studies lead us rapidly into the domain of the unknown.

He may then be able to solve some of the greatest problems which have baffled the most learned metallurgists of our day, namely, those of liquation and segregation; he may be putting together metals of varying degress of liquation and segregation with different powers of solvency in such a way that both chemical and physical equilibrium may be restored and that these proportions may be reciprocally varied at will, and in connection with proper heat treatment—all internal stresses may be balanced and uniformity of molecular structure be obtained.

The success of the brass foundry of the future will depend more upon the training of the man in physical and metallurgical science and his ability to apply his knowledge, than upon the machinery employed, desirable though it may be as an accessory to facilitate the production of his castings. In other words, the greatest possible factor for success lies in the development of the man himself.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Low Specific Gravity Alloy

I am building an engine on which I wish to use a very light metal for pistons that can be subjected to a temperature of at least 400 degrees Fahr. and also will have good wearing qualities. The metal is to be used in a valve where the pressures are entirely balanced, the valve being an elongated piston in form. If you know of any material that would be satisfactory for this work, I would like to have you advise me.

The only low specific gravity alloys available for the purpose mentioned are those of aluminum and probably what is known as the No. 12 alloy, consisting of 92 per cent aluminum and 8 per cent copper, would be the most suitable for your purpose. An alloy consisting of aluminum, 95.08 per cent; copper, 2.34 per cent; manganese, 1.78 per cent; iron, 0.52 per cent, and silicon, 0.28 per cent, possesses slightly more ductility than the No. 12 alloy and will resist corrosion to a greater extent. This alloy, which should consist of 96 parts of aluminum by weight, 2 parts of copper by weight, and 2½ parts of ferro-manganese, is made by melting a portion of the aluminum, superheated to a temperature of approximately 950 degrees Cent., to which the ferro-manganese is added in granular form and the copper in small pieces. This mixture should be well stirred, after which the balance of the aluminum is added.

Brass Bearing Mixture

Kindly furnish us with a mixture for brass bearings which contain a large percentage of heavy scrap.

The following alloy forms an excellent mixture for brass bearings: Copper, 77 per cent; lead, 15 per cent, and tin, 8 per cent. Any amount of scrap considered desirable can be used with a mixture of new metals; for example, 50 per cent scrap and 50 per cent new metal or 75 per cent scrap and 25 per cent new metal. However, unless the composition of the scrap is known, the resulting alloy may not be adapted to your purpose and, therefore, for important work, it is better to use the scrap in some other manner than in castings for bearings.

Aluminum Melting Difficulties

We manufacture aluminum cooking utensils, using No. 12 metal, which contains 8 per cent copper and 92 per cent aluminum. The castings have a good appearance, but pits develop when the surface is ground. We also would like a good aluminum solder which will take a high polish.

Aluminum will have to be heated to a high temperature before it can combine with carbon. If the aluminum is permitted to become very hot at any stage of the melting process, and if it is then stirred in such a manner that the sides of the crucible are scraped, incandescent spots will occur at such points, indicating that a union of the aluminum and the carbon of the crucible has taken place. This will result in the formation of aluminum carbide, some of which may be disseminated throughout the metal and will cause the black spots mentioned. To eliminate this difficulty, do not overheat the aluminum and add the copper in the form of a hardener, consisting of 50 per cent copper and 50 per cent aluminum. This hardener, can be made by

melting the requisite amount of copper and adding the aluminum and thereby all danger of overheating can be avoided. Cleanliness is one of the secrets of success in casting aluminum. The melting pots and all of the furnace tools used should be kept clean. As aluminum has a low specific gravity and is rather viscid when molten, it is liable to hold dirt in suspension. The aluminum should never be permitted to increase in temperature above a blood red heat.

A satisfactory aluminum solder can be made as follows: Zinc, 25 per cent; tin, 69 per cent, and aluminum, 6 per cent. Flux with venetian turpentine.

Misrun Castings

We are experiencing considerable difficulty with misrun castings. Our mixture consists of 17 pounds of pig copper and 40 pounds of scrap brass. Kindly let us know what mixture will give good results using scrap.

It is possible that the castings are being poured too cool, are improperly gated or are poured too slow. We would suggest that some attention be first given to these details. If the gates are too small, they should be enlarged and the metal should be poured hot and as speedily as possible. If the difficulty still continues, try the following mixture: Place 21¼ pounds of copper in the bottom of a crucible, on top of which charge 32 pounds of scrap and melt under a cover of charcoal. When hot, add 2½ pounds of zinc, 12 ounces of tin and 8 ounces of lead. The metal should be stirred well and poured hot.

Strengthening No. 12 Aluminum Alloy

What addition can be made to the No. 12 aluminum alloy, consisting of 88 per cent aluminum and 12 per cent copper, that will strengthen it to prevent the bending of match-plates for which it is used?

No. 12 aluminum consists of copper, 8 per cent, and aluminum, 92 per cent, and not aluminum, 88 per cent, and copper, 12 per cent, as stated in your inquiry. This alloy can be strengthened by the addition of tin, and it is advisable to begin by adding 1 per cent of tin and to gradually increase this until the requisite physical properties are obtained. The following alloy might prove satisfactory for your work: Copper, 3 per cent; zinc, 15 per cent; manganese-copper, 0.05 per cent, and the balance aluminum.

Sulphur in Alloys

Many of the bushing castings which we manufacture contain cold shuts to a depth of about ¼ inch below the surface. The metal is carefully melted under charcoal, is deoxidized with phosphor-copper and is cleansed with sulphur. One peculiarity of the difficulty we are experiencing is the fact that the outside only is affected, while the metal at the core is smooth and homogeneous. Our mixture consists of red brass scrap, 50 per cent; copper wire, 40 per cent; tin, 3 per cent, and lead, 7 per cent. We have been wondering whether this trouble might be traced to iron in the scrap and if so, how can this be corrected? We also would like to know how silicon-copper can be used as a deoxidizer and the possibility of introducing metallic sodium for the same purpose.

Your difficulty is caused by the use of sulphur, which will not cleanse any metal except the white group and then it should only be used sparingly and with a great deal of skill. All members of the sulphur group of elements are enemies of the brass founder. These elements include oxygen, sulphur, selenium and tellurium. The oxygen produces porosity and blow-holes and sulphur in alloys creates surface dirt on the castings, while selenium and tellurium cause gas pockets. It follows, therefore, that all of these elements should be excluded from nonferrous alloys, if possible To eliminate oxygen, phosphorus and other deoxidizers are added to alloys. Sulphur, unless it is added specifically, rarely is present in alloys in sufficient quantities to cause trouble, while selenium and tellurium are never sought out, although they are the cause of more difficulties in alloys than is generally appreciated. Omit the sulphur and if any metal is on hand that has been so treated, it should be remelted and 1 pound of ferro-cyanide of potassium should be added to each 100 pounds of metal sulphur-treated. Ferro-cyanide should be added to the molten metal by dropping it wrapped in paper onto the surface of the alloy. It should be permitted to remain undisturbed for a period of about 10 minutes to drive off the water of crystallization. The ferro-cyanide then is stirred into the metal with an iron stirrer. In introducing this salt, great care should be exercised to remove the water of crystallization, as otherwise an explosion would follow its introduction into the metal. Ferro-cyanide of potassium also is known as yellow prussiate of potash and can be purchased in almost every drug store. It introduces iron into brass in a chemically-combined form and in this condition it is an efficient deoxidizer, having a greater affinity for sulphur than copper.

Imperfect Melting Methods

We are experiencing considerable difficulty with our brass castings, owing to the fact that they are full of blow-holes. We melt in a natural gas crucible furnace and the brass mixture consists of 10 to 20 per cent phosphor bronze pig metal, the balance being brass scrap such as valves, lubricators, old journals and car brasses.

In all probability the difficulty will be found to be due to your methods of melting, although the mixture might be improved. In gas and oil-fired furnaces, it sometimes is difficult to keep the surface of the metal covered with charcoal. If this is the case in the present instance, we would suggest that every effort be made to remedy this fault. If the furnace is sufficiently deep to permit the use of a crucible ring, this should be tried. These rings can be made from old crucibles by chopping off the bottom with a hatchet. The ring will increase the depth of the crucible and will make it more difficult for the blast to blow off the charcoal. However, if you find it impossible to do this, use a covering of glass to protect the metal from oxidation. Also, your phosphor bronze pig metal might be omitted and phosphor-copper substituted therefor, 1 or 2 per cent of the 15 per cent alloy being used as a deoxidizer. When employed merely to clean the metal, a small amount of phosphorus is more satisfactory than a large amount, and this applies to all deoxidizers. The phosphor bronze ingots may be heavily phosphorized, the phosphorus having been added for the purpose of hardening the metal, and this may result in the introduction of too much of this element into your mixture. Valves and lubricators are considered fairly good scrap, but old journals are open to suspicion and car brasses should not be used except in the cheapest kind of castings. You will improve your mixture immensely by discarding the car brasses entirely.

Tough Manganese Bronze

Kindly furnish us with a tough, manganese bronze mixture, in pounds.

The following alloy will prove satisfactory: Copper, 56 pounds; zinc, 38 pounds; manganese-copper, 4 pounds; aluminum, 1 pound, and tin, 1 pound. First melt the copper, add the manganese-copper, followed by the aluminum, zinc and finally the tin.

A New Departure in Steel Foundry Practice

Method of Casting an Electric Steel Liner in an Open-Hearth Cast Steel Pump Casing

By S S Knight

FOR many years steel foundrymen have experimented with permanent molds, but owing to the many difficulties experienced, nothing more satisfactory than sand has been found for molding purposes. In instances where castings were small a limited degree of success has been attained with sandless molds, but wherever the amount of metal to be cast was large or the section heavy, failure uniformly resulted from such efforts. Another problem which steel foundrymen have tried to solve for years has been that of burning-on such parts of castings as might have been cut off by the sand, dropped from the cope or result from misplaced cores. Owing to the high temperature at which steel is melted for casting purposes, the burning-on process has never proved successful, owing to the fact that the material of the old casting did not reach as high a temperature as the steel poured in and when the cast cooled, the weld pulled apart, either in whole or in part.

Steel foundrymen also are familiar with the fact that sulphur and phosphorus cause checking and as a result it is unreasonable to expect success from efforts made to cast linings in other castings or to weld on pieces to broken or defective castings by the ordinary burning-on process.

To successfully accomplish the work shown in the accompanying illustrations, it was necessary to employ exceedingly low phosphorus and low sulphur steel. Fig. 1 shows the upper half of a 20-inch pump casing, the discharge half of the casing being illustrated in Fig. 3. This casing was cast from open-hearth steel and was worn out within a few months in handling water which contained a large amount of sharp sand. Each half of the casting contained a large number of holes through which the water gushed in such quantities that when the pump was in operation the work proved unprofitable to the dredging company. To remedy this difficulty, these casings were lined with a hard steel lining, which was cast into them and was welded throughout to the old material by the Columbia Steel Co. at its Pittsburgh, Cal., plant. The steel was made by the electric process and it analyzed approximately as follows: Carbon, 0.35 per cent; sulphur, 0.02 per cent; phosphorus, 0.004 per cent; manganese, 0.75 per cent, and silicon, 0.35 per cent. It will be noted that the sulphur and phosphorus content of this steel is exceptionally low. Under ordinary steel foundry operating conditions it would have been impossible to obtain the continuity of the casting lining and to secure a steel which would weld to the casting in which it was cast. The assembled casting is shown in Fig. 2. It is interesting to note that after this operation was completed, the two sections of the casing were successfully assembled and there was only a difference of 3/32 inch between their dimensions as repaired and the original size.

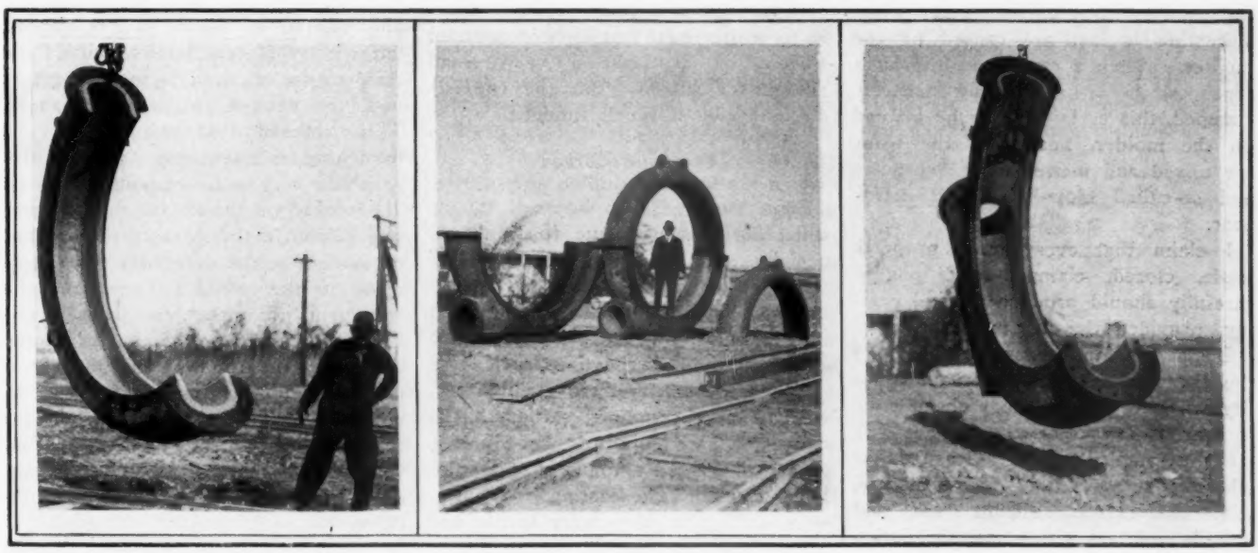


FIG. 1—UPPER HALF OF CASING, SHOWING CAST STEEL LINING

FIG. 2 — SUCTION PUMP CASING ASSEMBLED AND RELINED

FIG. 3—LOWER OR DISCHARGE HALF OF CASING AS RELINED

New Copper Alloy

A method of hardening copper or brass is the subject of a patent granted to William F. Nolan, St. Paul, Minn. Manganese, vanadium and aluminum are used and the mixture is made as follows: Copper, 98.15 per cent; manganese, 1.48 per cent; vanadium, 0.25 per cent, and aluminum, 0.12 per cent.

The Toronto, Can., branch of the Canadian H. W. Johns-Manville Co., Ltd., has been removed to more commodious quarters at No. 19 Front street, East. The store and warehouse has a floor area of approximately 35,000 square feet.

Semi-Steel, Its Development and Manufacture*

Suggestions for Effecting Economies in Foundry Practice by Scientific Mixing and Proper Melting Methods

By David McLain†

TO KNOW that iron contains carbon, silicon, sulphur, phosphorus and manganese is not sufficient; the successful mixer of irons must know what effect a given quantity of one element will have on the others, and as "An ounce of prevention is worth a pound of cure," he will buy pig iron most suitable for his particular line of work *when he knows how.*

Look out for the indiscriminate buying of scrap iron, as tons and tons of inferior material is shipped when miscellaneous scrap is bought.

Look out for the man who tells you pin-holes, blow-holes, or the thousand and one excuses given when a casting is lost are caused by the molder. When a casting is lost by a crush, drop or not being securely clamped, this certainly may be blamed on the molder, but when the irons are mixed and melted right, pin-holes and so-called blow-holes will disappear.

I claim that every mold properly made, closed, clamped and poured carefully should produce a good casting, provided the mixture is right.

Look out for the man who buys the cheapest coke, as observant foundrymen have learned that cheap coke is dear at any price.

Some foundrymen have learned that when coke is of good structure, with the carbon, sulphur, ash and volatile matter within certain limits, it is good fuel. They specify that it must be within those limits when purchasing, then they have each shipment analyzed to learn whether it is up to the specifications or not. If not, they are entitled to a rebate.

There is one kind of coke you should never buy. It is money wasted. You can get along without it and melt more iron and more steel scrap than you do now, making better castings. It is the coke that you can save.

If all foundrymen bought pig iron and coke on specification, there would not be much inferior iron or coke on the market. If foundrymen are careless, the seller cannot be blamed. But if you compel him to make high grade material, he will do so.

If you find that the material is bought by guess, then you may rest assured that it is mixed by guess, which is poor practice.

Probably, like myself, you are puzzled by many of the claims made by various writers. I am still puzzled by one which follows: "Carbon in molten iron is all combined."

I am positive that the man who wrote this first, must have made a mistake, but it has been much easier for later writers to copy his remarks than to work out the puzzle to a satisfactory conclusion. I believe the originator of this claim referred merely to white iron, that is, iron without silicon, or at least a very small amount of silicon. But the copyists did not give it much thought.

Combined Carbon

This theory I also believed at one time, but it caused me to think especially when pouring light, thin sections. Such castings set almost instantly, but analysis will show that they contain practically no combined carbon, providing the mixture is soft.

When the mixture was medium soft, we had more combined carbon, but if it was a hard mixture, we found a greatly increased amount of this combined element. The castings, of course, were useless, as they were brittle and were liable to crack in the molds.

Years ago chemists and metallurgists claimed that carbon in the molten metal was all in the combined form and they kept unceasingly at the founder to regulate his mixtures by carbon and insisted that the carbon be taken on every test. However, I could not agree with this theory, believing that by regulating the silicon and other metalloids and melting the iron in a sane manner from day to day, the metal would produce satisfactory castings for the purposes for which they were intended.

Carbon is the element that gives iron its characteristic qualities of hardness and softness, and may be controlled or regulated by silicon, the other elements, rate of cooling and scientific melting.

When I began experimenting with steel scrap in cupola mixtures 13 years ago, I naturally turned to the published works on metallurgy, where I found this statement:

Steel cannot be melted successfully in a cupola, as it will not fuse or mix with iron. It will therefore cause hard spots.

If steel scrap is placed on the bed charge, it will not melt until the third or fourth charge, and it will bung-up the cupola.

At the time this claim was made, many foundrymen had been melting steel in cupolas for years and one man in particular had been successful with semi-steel for heavy sections. I was a steelmaker originally, therefore, I knew the value of manganese and wanted to use it in the cupola, but writers of text books claimed the temperature required to melt iron was not high enough to melt manganese. They claimed that manganese is a hardening element, as it converts graphitic carbon to combined carbon.

I worked on the theory that if there was silicon in the mixture the amount of silicon would determine the hardness of the metal. Therefore, the statement that the manganese converts graphitic carbon to combined carbon appeared correct if there was no silicon in the mixture, but as silicon converts combined carbon to graphitic carbon, I wondered what would happen if silicon and manganese were both present in fair quantities.

Text books state that steel is used to reduce total carbon. This also is incorrect, as steel, owing to the low percentage of the elements, will absorb large quantities of carbon from the coke and other elements from the molten iron.

It was apparent that high manganese was necessary because manganese increases the saturation point of iron for carbon, and reduces sulphur when high, and as I wanted to use a large percentage of steel in the mixture, it was necessary to have a low sulphur content in the metal.

When I figured the estimated analysis of the material of the charge entering the cupola during my first trial, the total carbon was only 2 per cent. Regardless of how high the silicon was in the castings, they would be hard if the total carbon was

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*From a paper presented before the Superintendents' and Foremen's Division of the Chattanooga, Tenn., Manufacturers' Association.

†McLain's System, Milwaukee.

only 2 per cent, but when the metal was poured and analyzed it was found that the carbon had increased to 3.58 per cent, yet the light castings were soft, although the silicon was low.

The steel and manganese did exactly what they were calculated to do; they increased the total carbon, reduced the sulphur and allowed the lower silicon mixture to be used, thereby giving a close-grained metal, free from segregation and blow-holes.

Lately a patent was granted an eastern foundryman to remove a percentage of sulphur from molten cast iron. The patentee claims to be able to reduce the sulphur content, 30 to 50 per cent. He states:

Many castings are lost on account of defective spots of various sizes, attributed to kish, sand or oxides, and analyses of these spots proved abnormal amounts of sulphur, manganese and carbon.

By introducing air through a pipe with a 1/16 inch hole in the bottom of the ladle of molten iron, this starts an ebullition creating manganese oxide, which owing to its affinity unites with sulphur to produce a slag which rises to the top of the ladle, where it may be skimmed off. Analyses of the slags will show a large increase of silicon, sulphur and manganese.

Removing Sulphur

Foundrymen know that I have been preaching the use of manganese to reduce sulphur, but remove the sulphur in the cupola where the iron is boiled. After it is run into the ladle, more impurities work up through the metal and this slag produced in the ladle contains a large amount of manganese sulphide. Foundrymen in all parts of the world are using small percentages of steel in cupola mixtures today and, while they may only use as low as from 2 to 5 per cent, they call it semi-steel.

When I gave to the world this new metal, instead of giving it a fancy name, or a misleading one, I called it semi-steel, although the term had been abused for years and will continue to be used and abused as long as men are satisfied with a mere superficial knowledge of the greatest modern discovery relating to iron foundry practice. Technical men claim there is no such thing as semi-steel—that the steel loses its identity and that it is only gray iron. They forget that pig iron is used to make steel and while the iron loses its identity, they call the resultant metal steel.

Electric Furnace for Copper Alloys*

By G H Clamer

THE development of the Hering furnace has been progressing favorably. Being a departure in design, much of the necessary data for the best proportions had to be obtained by actual trial on furnaces themselves, as it did not exist in books and tables; among this data were a number of physical constants which are beyond the ranges given in tables. Moreover the data had to be obtained on a practical scale as distinguished from a laboratory scale. Development work of this kind requires running a furnace to destruction in order to find out its weak points.

Briefly, the furnace is of the resistance type (that is, not an arc furnace); the metal is heated, like the filament in an incandescent lamp, by passing the current through what might be termed a thick filament, or column, of the liquid metal. The furnace itself consists of a hearth, having two, three or four cylindrical holes in the bottom, which are closed at their far ends by the electrodes. These holes may be vertical, horizontal or preferably inclined upwards into the hearth, and of course are filled with the molten metal of the hearth.

By means of the electrodes, the electric current is then made to pass through the columns of metal in these holes, thereby heating very rapidly. The proportions are made such that all the heat of the furnace is generated in the metal in these holes. In addition to thus heating the metal, the current also exerts a peculiar force by means of which it circulates the metal rapidly in these holes by forcing it out into the bath and sucking fresh liquid metal into the holes; hence the heat of the furnace, which is originally set free in the holes, is rapidly transmitted to the bath of metal in the hearth, and in addition a most thorough mixing and stirring occurs. It is this circulating force, popularly known as the *pinch effect*, which is the basis of the furnace and which makes such a method of heating possible.

Melting the Metal

Cold metal is melted by immersion in this heated bath. The hearth is kept closed, thereby avoiding any loss of zinc vapors. It is opened only while cold metal is being inserted. Moreover, the space in the hearth above the metal can be kept neutral or even reducing, whereby all oxidation is prevented. The furnace can be made tilting if desired, as the transformers for the electric current are attached permanently to the outside. As the walls may be made thick, the furnace gets only slightly warm on the outside, even after continuous running night and day. The furnace itself is simple in construction and the only perishable part, the hearth and heating holes, are easily renewed when worn out.

Brass, bronze, copper, lead, iron, steel, ferro-silicon, etc., have been melted in it repeatedly. It has been run day and night continuously without any undue overheating in any parts.

The development has been effected with small furnaces of about 25 to 30 kilowatts, and has been greatly retarded by the transformers not giving their rated capacities, for which, of course, the furnaces were not responsible. Being only small furnaces the loss of heat per pound of metal was necessarily greater than it would be in a large, well-built, commercial unit. Moreover, much heat was lost through the top, which was only crudely closed. No particular efforts were made in these tests to economize the heat, as it will readily be seen that this can be done effectively in a large, properly built furnace, and involves no difficulties, depending merely upon how thick one is willing to make the walls and cover. The recent development had to do chiefly with finding the best form and proportions of the water-cooled electrodes and the best dimensions of the heating holes, on which latter the effectiveness of the circulation through them so greatly depends; the greater this circulation the smaller the furnace for a given duty.

Notwithstanding that no particular efforts were made to economize the heat losses, the results were favorable considering the small size of the furnace, and the fact that the trans-

(*Continued on page* 80)

*Presented at the Chicago meeting of the American Institute of Metals.

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Contents

TELPHER SYSTEMS APPLIED TO FOUNDRY OPERATIONS 41
NEW PATTERN PLATE COMPOSITION 47
PRECAUTIONS FOR SAFEGUARDING FOUNDRY EMPLOYES 48
SCABBING AND RAT TAILS ON CASTINGS 52
BOOK REVIEW 52
MOLDING IRON BOILER BASES BY A NEW METHOD 53
THE PROPER CONSTRUCTION OF PATTERNS 54
THE HEIGHT OF A CUPOLA BED 55
LEAD ALLOY 55
EFFICIENCY IN THE PLATING ROOM 56
ENAMEL FOR AUTOMOBILE RADIATOR CAP 58
ANODE MIXTURES 58
MATTE SURFACE ON GERMAN SILVER 59
HOW TO REMOVE NICKEL PLATE 59
USE OF THE HYDROMETER 59
SAWING GEAR TEETH 60
A MALLEABLE ZINC ALLOY 60
A MODERN WISCONSIN GRAY IRON FOUNDRY 61
RUSTING OF COOKING RANGE TOPS 66
BOOK REVIEW 66
SUGGESTIONS FOR MAKING ALUMINUM CASTINGS 67
NEW ENGLAND FOUNDRYMEN ELECT OFFICERS 68
DESCRIBES MANUFACTURE OF CARBORUNDUM 68
APPROXIMATE MELTING POINTS OF COPPER ALLOYS 69
THE BRASS FOUNDRY OF THE FUTURE 71
LOW SPECIFIC GRAVITY ALLOY 73
BRASS BEARING MIXTURE 73
ALUMINUM MELTING DIFFICULTIES 73
MISRUN CASTINGS 74
STRENGTHENING NO. 12 ALUMINUM ALLOY 74
SULPHUR IN ALLOYS 74
IMPERFECT MELTING METHODS 74
TOUGH MANGANESE BRONZE 74
A NEW DEPARTURE IN STEEL FOUNDRY PRACTICE 75
NEW COPPER ALLOY 75
SEMI-STEEL—ITS DEVELOPMENT AND MANUFACTURE 76
ELECTRIC FURNACE FOR COPPER ALLOYS 77
TRADE OUTLOOK 78
DR. MOLDENKE RESIGNS SECRETARYSHIP OF A. F. A. 79
A STATIONARY HEAD SQUEEZER 80
TABOR 8-INCH POWER SQUEEZER 81
A NEW ROLL-OVER CORE MACHINE 81
AN ALL-STEEL FOUNDRY RIDDLE 82
PERSONAL 82
SHRINKAGE AND EXPANSION 82
GENERAL INDUSTRIAL NOTES 83

Trade Outlook

SINCE the first of the year foundry trade conditions have improved slightly and there is every indication that the low point in the country's melt has been passed. With few exceptions, casting plants are operating with reduced forces, but the general situation shows a distinct improvement over that prevailing during the closing months of last year. Gray iron jobbing shops report an increase in new tonnage, and the demands of the automobile and motor truck industry have grown to fairly large proportions. The implement trade, unfortunately, is suffering from the effects of the 1913 lull, and with warehouses stocked to their capacity, the number of new machines that is being built for the ensuing season is less than two-thirds of last year's output. As a result, the casting requirements for this tremendous industry have been greatly curtailed and malleable and gray iron plants dependent upon this class of work are operating considerably below normal capacity. Railroad buying likewise is on a conservative basis and purchases are made to cover immediate needs only. Steel founders report better inquiry and a greater disposition to place tonnage than has existed during the last six months and the outlook for February throughout the entire foundry trade is considerably brighter than at any time since October. Prices, however, are low and the disposition generally is to quote on a basis that will insure the placing of the business. Brass and aluminum foundries report better inquiry and the requirements of automobile manufacturers show a satisfactory increase over December. In the steel trade the change toward better sentiment is marked and there has been some increase in the volume of business. Prices generally are no longer yielding, which would indicate that bottom has been reached. The railroads are placing some orders for their season's rail requirements and pig iron buying in some centers has reached large proportions. Cast iron pipe manufacturers have taken advantage of the low prices that are being quoted and have purchased large tonnages from makers in the south. In the Buffalo district a $12 quotation for No. 2 foundry resulted in heavy buying, which was followed by advances of from 50 cents to $1 a ton. At Birmingham, No. 2 foundry iron is quoted at $10.50 and pipe foundries closed for their needs on this basis. In the Chicago district attractively low prices have led to the placing of large orders by a number of stove interests, and steel founders, particularly in the St. Louis district recently have taken on large tonnages of basic iron. Some Tennessee warrant iron also has been placed on the market at a price which some Alabama producers have met. In the leading centers foundry grades of iron are quoted as follows: No. 2, Pittsburgh, $13.65; Cleveland, $13.50; southern Ohio, Cincinnati, $14.20; Chicago, northern, $14.25; Buffalo, $12.50 to $13; Birmingham, $10.50 to $11, and Philadelphia, $14.25; basic, Pittsburgh, $13.40, and $14, Philadelphia; malleable Bessemer, $13.90, Pittsburgh, and $14.25, Chicago, while Lake Superior charcoal is held at $15.50, Chicago delivery, for No. 1 to No. 4 grades.

The production of crucible steel in 1912 amounted to 121,517 tons, against 97,653 tons in 1911, an increase of 23,864 tons, or 24.4 per cent. The maximum production was reached in 1907, when 131,234 tons were made. Pennsylvania was by far the largest producer with the total of 63,687 tons.

Dr. Moldenke Resigns Secretaryship of A. F. A.

American Foundrymen, However, Desire to Retain Part of His Services and Offer Position of Editorial and Foreign Secretary

AT A recent meeting of the executive committee of the American Foundrymen's Association, held at the La Salle hotel, Chicago, Dr. Richard Moldenke, secretary, tendered his resignation, which was reluctantly accepted. Appreciation of Dr. Moldenke's long and valuable services to the association, extending over more than a decade, was expressed by the members of the committee.

For some time Dr. Moldenke has been seeking to be relieved of the burden of his duties and the members of the committee felt it incumbent on themselves to accede to his request. In order that his services, in a measure, may be retained, he was tendered the position of editorial and foreign secretary of the society, which, it is believed, he will accept. To fill Dr. Moldenke's unexpired term, an appointment shortly will be made by Alfred E. Howell, president. During his term of office, Dr. Moldenke witnessed the growth of the American Foundrymen's Association from a small organization with a limited membership to one of the leading technical societies of the world. Its work has received recognition in every country where metals are cast and to its influence must be attributed directly the promotion of similar bodies in England, France, Germany and Sweden. Nor was Dr. Moldenke's helpfulness limited to the routine duties of his office. His wide experience was cheerfully extended to every foundryman beset by difficulties and the foundry world owes him a debt of gratitude that can be repaid only by according him the distinction which he so richly deserves. While essentially a metallurgist and an expert in malleable practice, Dr. Moldenke's investigations were directed into almost every branch of foundry work. His research into gray iron cupola practice has revolutionized charging methods, has effected great economies in melting and has greatly reduced casting losses. At St. Louis, during the world's exposition in that city, Dr. Moldenke conducted a series of tests on coke for metallurgical purposes, which was the first investigation of its kind undertaken and his conclusions threw new light on the foundry fuel problem.

DR. RICHARD MOLDENKE,
Retiring Secretary American Foundrymen's Association

Through his affiliation with the International and American Societies for Testing Materials, Dr. Moldenke was in position to serve in an official capacity on their committees on specifications for foundry pig iron, gray and malleable cast iron, and largely due to his efforts can be traced the adoption of these standards which are accepted by the trade, not only in the United States, but also abroad.

Dr. Moldenke has been a frequent contributor to technical journals and his papers, read before various societies constitute a considerable part of existing literature. Notwithstanding his facility as a writer, he has only one book to his credit, "The Production of Malleable Castings", having been compiled from a series of articles published in THE FOUNDRY, which later were amplified for this work. A number of his investigations were made on behalf of the United States government under the auspices of the Bureau of Mines which has issued several bulletins containing the results of his researches. In recent years Dr. Moldenke's consulting work has grown to large proportions and it was only at a tremendous personal and financial sacrifice that he continued to perform his duties as secretary of the American Foundrymen's Association. At his home in Watchung, N. J., he has a modernly equipped laboratory, which includes a small cupola that enables him to make test heats and which greatly facilitates his research work.

Plan Chicago Convention

A preliminary meeting of Chicago foundrymen to make arrangements for the 1914 convention of the allied foundry associations was held at the La Salle hotel Monday, Jan. 12. A temporary local organization was perfected, of which Charles B. Carter, of the American Brake Shoe & Foundry Co., is chairman, and Oliver J. Abell, of *The Iron Age*, secretary. Permanent local committees will be organized at an early date. The convention arrangements this year will be somewhat different than they were last year owing to the fact that the funds for the entertainments have already been provided and the Chicago foundrymen will not be called upon to contribute any large sums.

Some of the details of the entertainment program have been tentatively arranged. It is expected that there will be a banquet Monday evening, Sept. 7, at the new Fort Dearborn hotel, at which members of the Associated Foundry Foremen will be entertained. The annual subscription dinner will take place at the La Salle hotel, Thursday evening, Sept. 10. One evening during the week

will be given over to a visit to White City, one of Chicago's most prominent amusement parks. All of the attractions of the park will be thrown open to the visiting foundrymen. The ladies probably will be entertained at a luncheon at the Stock Yards Inn, Wednesday, Sept. 9, and additional entertainment will also be provided for them. A movement is under way to arrange a visit to Milwaukee on the Friday following the close of the convention. Of course the program as outlined is purely tentative, and may be changed in several of its details.

Electric Furnace for Copper Alloys

(*Continued from page 77*)

former could not supply more than about half of its rated output for which the furnace was built.

Ordinary yellow brass was melted repeatedly, including superheating, at a rate of about 8.7 pounds per kilowatt-hour. Considering the abnormal losses in the transformer and the fact that no special efforts were made to economize the heat losses, the furnace being frequently opened at the top, these results are considered quite favorable. With conservative estimates, it is thought that this figure might be increased to 10 pounds and probably more. The figure for theoretically perfect operation is not known definitely, but is believed to be about 14 pounds.

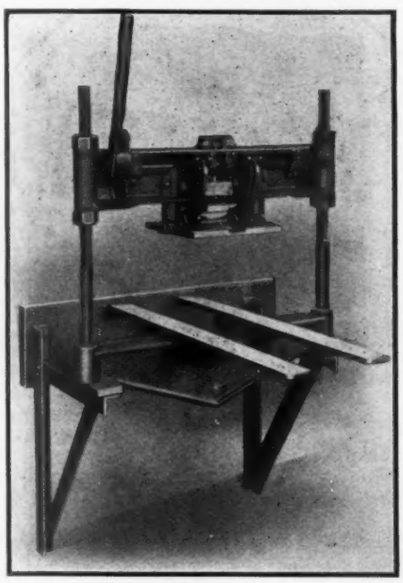
At 1 cent per kilowatt-hour, this would, therefore, mean about 10 cents per 100 pounds. However, it is not proper to compare this figure directly with the fuel cost for melting brass in the usual combustion furnace, as there are other factors of equal or even greater importance which should also be included. Among these is the reduction in the loss of zinc, which in the fuel furnaces sometimes involves an even greater cost than the fuel cost. Concerning the loss of zinc in the furnace, the best indications that there is practically none, is that there is an almost entire absence of any white fumes coming out of the furnace. The only loss of zinc by white fumes was from the thread of metal as it was being poured out, and this of course cannot be avoided in any furnace.

There is, furthermore, no loss of metal by spattering; all the metal that is put into the hearth must come out, without loss, as melted metal.

There is no loss by oxidation, as the atmosphere in the furnace may always be made reducing with a little charcoal. The losses by combustion with sulphur in the fuel gases are of course also entirely absent. The saving of the losses of metal, therefore, are of great importance, and in some cases might alone pay for the cost of the electric power.

The wear on the lining in a brass furnace has been found to be so slight that this cost of relining, per 100 pounds of metal, will undoubtedly be almost insignificantly small. As to what the saving in labor cost will be has not yet been determined, but there is not any question that the labor cost will be considerably reduced, as will also the foundry floor space per ton per day, as these furnaces may to advantage be forced, hence may be made to give a relatively greater output per day.

It might be added that it has been shown that there is no difficulty whatsoever in getting the required high temperature, for by simply leaving the



ARCADE SOLID HEAD SQUEEZER

metal in the furnace a little longer the temperature will rise to any amount desired.

The fact that the liquid metal is continuously circulated upward, like boiling water in a kettle, brings all mechanical impurities, gas bubbles, etc., including no doubt also the sulphides and oxides, to the top, leaving the metal pure. With a blanket of charcoal over the top, some of the oxides might even be reduced.

The furnace, of course, may be made tilting, as all those under construction now are, and they may, if desired, be made to tilt around the lip, thereby facilitating the pouring directly into ingots or molds.

It might be of interest to add that copper has been easily melted repeatedly in these furnaces. This was one of the unexpectedly favorable developments, because copper has such a low electrical resistance that resistance furnaces for copper have heretofore been impracticable. In the present furnace the proportions of the heating holes for copper do not become impracticable, though it was feared at first that they might be.

Water Cooled Electrodes

One of the chief and most difficult parts of the furnace to develop was the water-cooled electrodes connecting the transformer with the melted metal in the bath. A successful form of construction of these parts has now been devised and tested out, and has given entire satisfaction. It also has been found that the circulating force may be made much greater than was at first supposed, and this makes the design and proportions of the heating tubes more favorable, and reduces the size of that portion of the furnace. This circulating force was in one test so great that the liquid metal rose about an inch above the surface where it was squirted upwards; the velocity was so great that at times drops of metal were thrown off at the surface by this rapid evolution, though not enough to spatter the metal. If a suitable pyrometer exists to be placed into the heated metal, it is possible to regulate the temperature with great precision, thereby avoiding both under and overheating.

In a small 10-kilowatt furnace, what is known electrically as the power factor, was accurately measured and was found to average about 93 per cent, which is greater than was expected and is practically perfect. In a larger furnace a crude measurement gave about 85 per cent, but it is believed that the instruments may have been somewhat in error and that it was probably higher.

A Stationary Head Squeezer

The Arcade Mfg. Co., Freeport, Ill., has developed a stationary head squeezer, which is shown in the accompanying illustration. It is similar in all respects to the swing-head squeezer, built by this company, except that the uprights supporting the head are fixed. The cross rail carrying the squeezer plate may be adjusted vertically by means of nuts. A powerful toggle movement is employed. The operating lever is interchangeable and may be placed at the left or right side of the machine, as desired. The bearings are all of the sand-proof type.

The Baltimore branch of the H. W. Johns-Manville Co., New York, is now located in a modern six-story building at 207-13 East Saratoga street.

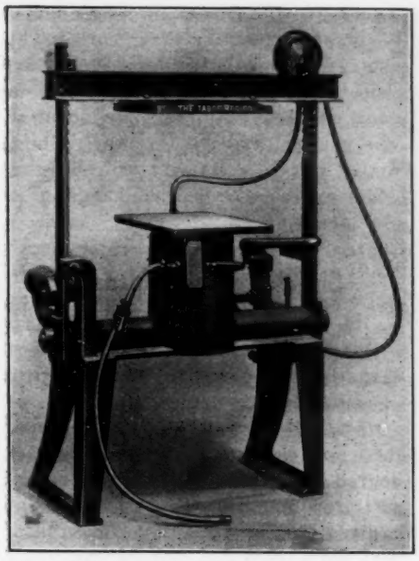


FIG. 1 — TABOR 8-INCH POWER SQUEEZER MOUNTED ON LEGS

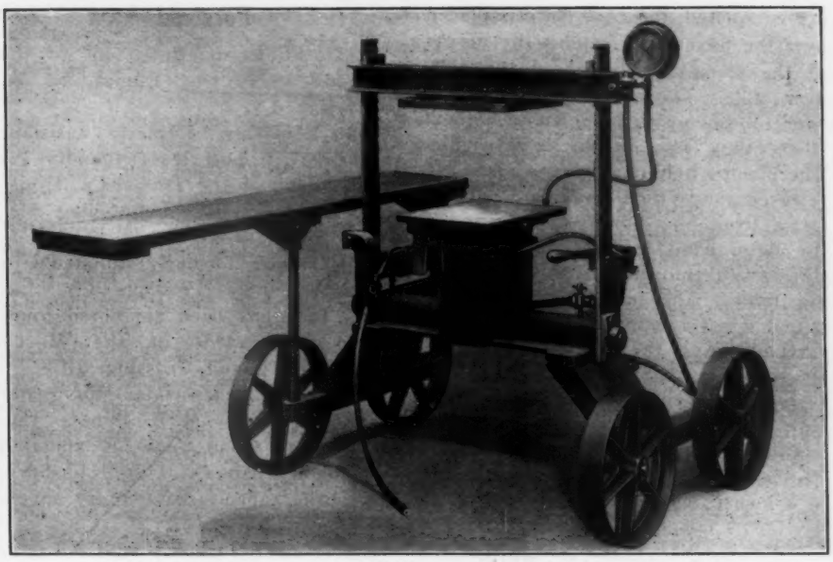


FIG. 2—TABOR 8-INCH POWER SQUEEZER MOUNTED ON WHEELS TO STRADDLE THE SAND HEAP

Tabor 8-Inch Power Squeezer

To take care of light work requiring a quick-acting machine of comparatively small size, an 8-inch power squeezer has been designed by the Tabor Mfg. Co., Philadelphia, which can be furnished either mounted on legs, as shown in Fig. 1, or on wheels, as illustrated in Fig. 2. All of the features of the Tabor 10-inch squeezer have been incorporated in this machine and, in addition, numerous other features have been added which adapt it especially to a particular class of work that heretofore has been made on machines too large to obtain the best economy in air consumption and output. The machine mounted on legs, shown in Fig. 1, permits the operator to get closer to the work than the wheel base machine and it is so designed that the base can be kept clear of sand. The wheels of the machine, shown in Fig. 2, are spread apart to permit it to straddle the sand heap. This machine is provided with a shelf to carry bottom boards and for use in closing molds, the machine following the sand heap, the molds being left behind as the squeezer is moved forward. The valves on both types are of the pop throttle type, which eliminates leakage and excess air consumption. These machine are 30 inches between uprights, have tables 12 x 16 inches and are provided with pressure gages and blow valves.

A New Roll-Over Core Machine

A roll-over machine, designed specially for economically making light cores in quantities, has recently been perfected by the Arcade Mfg. Co., Freeport, Ill. It consists of a frame carrying two cast iron plates or tables, as shown in Fig. 1. One of the tables is hinged so that it may be rolled over and is also provided with clamps for holding the core plate; the other may be raised or lowered vertically. When in use, metal core boxes are screwed to the roll-over table and are filled with sand and struck-off in the ordinary manner. The ramming is accomplished by jolting the cores against the two posts shown at the right, in Fig. 2. After the ramming operations

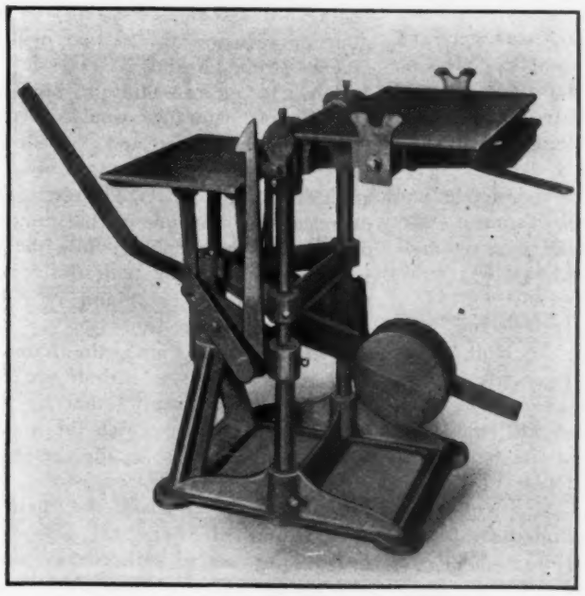


FIG. 1—ARCADE CORE MACHINE, SHOWING JOLT TABLE SUPPORT REMOVED

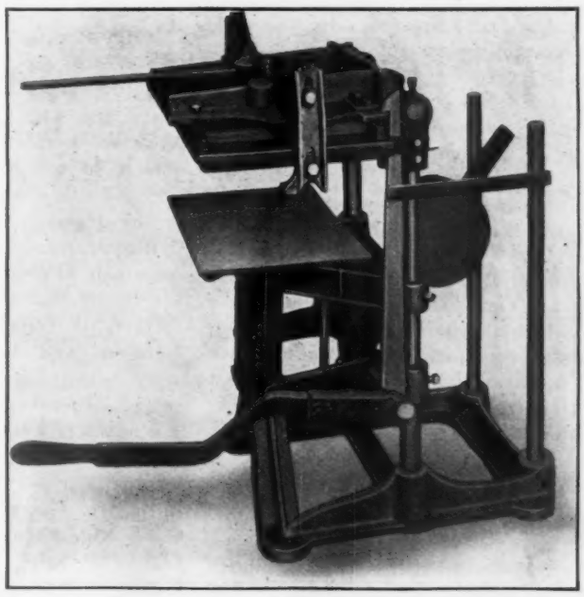


FIG. 2—CORE MACHINE IN ROLL-OVER POSITION

are completed, the core plate is placed over the boxes and fastened by means of the clamping fingers on the roll-over table. The cores are then rolled over to the position shown in Fig. 2, where they rest on the lower table. The clamps holding the core plate are released and the cores are drawn away from the boxes by means of the large hand lever, which controls the vertical movement of the receiving table. The best results are obtained when a helper is employed for carrying away the cores so that the coremaker has nothing to do but operate the machine. The machine is built in several sizes to accommodate various classes of work, the standard size being designed to make cores up to 4 inches in depth.

An All-Steel Foundry Riddle

An all-steel, truss-stamped rim riddle is being offered to the foundry trade by the American Implement Co., Waterbury, Conn. As shown in the accompanying illustration, the rim is made of No. 22 gage steel in one piece and is provided with a broad hand hold on the bottom edge. In combination with this hand hold is the customary ⅞-inch clearance for the fingers of the operator under the mesh. The rim is so constructed that the rapping of the riddle on the bench to clean a clogged mesh serves to tighten the mesh and this feature in combination with the trussed-stamping imparts rigidity that is absolutely devoid of wind and prevents the sides from collapsing even under the heaviest loads to which the riddle can be subjected. Cracked or splintered rims are eliminated and rivets can be replaced by electric welding. The mesh is inserted and pressed into the holding device by an automatic machine, which exerts a pressure of 20,000 pounds. This operation stretches the mesh to drum-head tightness, each wire in the mesh becoming a cross wire. High grade mesh in steel, galvanized and brass wire is employed and the rims are coated with "Battleship Gray" rust-resisting paint. Unfortunately, in foundry operations riddles are employed for many purposes for which they are not intended, from seats at the lunch hour, to tote boxes for furnace clinkers, gaggers, etc. It is claimed that this riddle will successfully withstand all such abuse. The American Implement Co. has a capacity for producing these riddles at the rate of 1,000 per day.

The Modern Pattern Works, Cincinnati, has secured larger quarters at 1628 Plum street, that city, and will move to that location within the near future.

Personal

T. C. Flinn, superintendent of the Kennedy Valve Co., Elmira, N. Y., has resigned.

John Kearsley, formerly assistant to the late Robert Ross, foundry superintendent of the Draper Co., Hopedale, Mass., has been appointed successor to Mr. Ross.

C. J. Houck, formerly affiliated with the M. Rumely Products Co., Laporte, Ind., has been appointed foundry superintendent of the Mason Davies Co., Grand Crossing, Ill.

T. P. Good, associated for many years with the W. & B. Douglas Co., Middletown, Conn., now is affiliated with the Fairbanks Co., St. Johnsbury, Vt., in the capacity of foundry superintendent.

J. F. Nestor, formerly affiliated with the General Electric Co., Lynn, Mass., now is connected with the United Novelty & Plating Co., West Medford, Mass. Mr. Nestor has charge of this company's plating department.

ALL-STEEL FOUNDRY RIDDLE

Charles J. Caley, general superintendent of Canadian Yale & Towne, Ltd., St. Catherines, Ont., Can., has resigned his position, effective March 1. Mr. Caley has no definite plans for the future. His address after March 1 will be 65 Olive street, New Haven, Conn.

Harry C. Carpenter, manager and treasurer of the Taunton Crucible Co., Taunton, Mass., during the past two years, and who recently resigned, was tendered a farewell banquet by the officers of the Reed & Barton Silver Co. and the Bay State Crucible Co. at the Hazelton hotel, Taunton. Mr. Carpenter was presented with a handsome pair of gold cuff links by a number of his Taunton friends.

Harry D. Gates, secretary and sales manager, and Foster J. Hull, engineer, have resigned from the Pangborn Corporation, Hagerstown, Md., and now are associated with the Mott Sand Blast department of the De La Vergne Machine Co., New York City. Both Mr. Gates and Mr. Hull have had a wide experience in the sale and design of sand blast equipment for foundry use.

William Jacobus has established an office at 38 Park Row, New City, where he will engage in scrap metallurgy and metal salvage work. This profession is unique and it is believed that Mr. Jacobus is the first to engage in this business. He formerly was scrap expert for the United States navy department and has had wide experience in the handling of old metals.

Shrinkage and Expansion

By W. J. Keep

Question:—Is shrinkage, as applied to cast iron, analogous to the co-efficient of expansion?

Answer:—In textbooks will be found the co-efficient of expansion for each degree of increase in temperature of cast iron and other materials, but no explanation is made of how these data were obtained nor of the grade of iron used. Shrinkage, however, is not analogous to contraction and expansion, the latter being due to heat loss or gain. If a casting is poured at a temperature of 2,300 degrees Fahr., it will contract for each degree of loss in temperature until the temperature of the atmosphere has been attained. If it is reheated again, it will expand substantially the same amount for a given number of degrees. Therefore, expansion and contraction are practically the same. However, the contraction of castings of varying chemical compositions, from the instant of solidification to atmospheric temperature, varies to some extent. If the change in chemical composition produces a definite change in shrinkage, then the reverse is true, namely, that the measure of shrinkage reflects a change in chemical composition. Decreasing the percentage of silicon, increasing the sulphur or reducing the carbon, will increase shrinkage and all may act together. In an iron mixture, high sulphur coke naturally would increase the sulphur content and the shrinkage is increased proportionately. In addition, if not analyzed, scrap may decrease the carbon in the mixture or increase the sulphur, while the pig iron may not run uniform. High shrinkage usually is found in close-grained, hard cast iron.

Within certain limits, the foundryman cannot regulate carbon nor sulphur and it is essential that he purchase the best coke which the market affords. Care also should be exercised in purchasing pig iron and usually he will be given the chemical composition of every car lot. The fracture of scrap will convey some idea of its chemical composition and with this information at his command, the foundryman undoubtedly

will be able to calculate his mixture. A subsequent analysis of his castings will show how well he has succeeded in meeting the required specifications and if he has not succeeded, changes readily can be made to obtain the desired quality. To obtain this result, however, the foundryman can take a short cut, as he undoubtedly has found from experience that castings of a desired grain, which would machine readily had a shrinkage of 0.15 inch when measured by a ½-inch square test bar, 1 foot long. If the test bar continues to show this shrinkage, the foundryman can rest assured that his castings are satisfactory, but if the shrinkage is increased to 0.175 inch, it indicates that he may have hard castings, which are liable to crack as the pattern was proportioned for the standard shrinkage of 0.15 inch per foot. By the addition of silicon, the shrinkage can be reduced to the standard and by the addition of pig iron containing a fairly high percentage of silicon, this result can be obtained. Experience also has shown that an increase of silicon, to a large extent, is an antidote for high sulphur or low carbon. On the other hand, if the shrinkage falls below the standard, additional scrap can be used in the mixture. By varying the percentage of silicon to maintain a uniform shrinkage, the castings invariably will be uniform in quality.

The question might be asked if castings contract or expand for each degree of heat, what causes the variation in shrinkage that is used to control quality? When the temperature of the casting passes from a bright red to a dark red, which barely can be distinguished by the eye, carbon changes from the combined to the graphitic state, momentarily increasing the temperature and causing the casting to expand or swell. This action is increased by phosphorus. While the casting is cooling it is shrinking from the loss of heat, but suddenly the molecular action generates heat and swells the casting. The amount of this expansion is subtracted from the total shrinkage. As the amount of expansion varies with the variation in chemical composition, so the shrinkage varies with such composition. With high silicon and high phosphorus in a mixture, there are three distinct expansions of the iron and the measured total shrinkage is low.

A four-page bulletin, issued by the Independent Pneumatic Tool Co., Chicago, is devoted to this company's line of piston air drills, pneumatic hammers, wood boring drills, portable air grinders, screw feed drills and other pneumatic tools.

The Calumet Steel Co., Commercial National Bank building, Chicago, is manufacturing gaggers made from twisted steel bars in various sizes from ¼ to ¾ inch. In addition to the twisted bars, plain rounds also can be furnished and these will be bent in any form to meet the requirements of various casting plants.

The Bureau of Standards, Washington, D. C., announces that it is prepared to issue sheet brass samples of the following composition: Tin, 1 per cent; lead, 1 per cent; copper, 70.3 per cent; zinc, 27 per cent; iron, 0.3 per cent, and nitrogen, 0.5 per cent. The sample weighs 150 grams and the fee is $3 each.

The El Paso, Tex., branch office of the Sullivan Machinery Co., Chicago, has been removed from 506 San Francisco street to 511-512 Mills building, that city. Don M. Sutor is the local manager of the company. The former quarters on San Francisco street will be maintained as enlarged warerooms in which compressors, drills and other machinery are carried in stock.

T. A. Willson & Co., Inc., Reading, Pa., have prepared a series of pictures grouped on a card illustrating the results of workmen neglecting instructions in the use of safety devices. In addition, a polyglot danger card has been designed. These cards will be furnished to any plant for distribution among its employes and for posting to direct attention to the necessity of the use of goggles in hazardous work to safeguard the eyes.

The Production Engineering Co., 1716 Spring Garden street, Philadelphia, has received an order for the erection of a foundry building 90 x 126 feet, to be erected for the De La Vergne Machine Co. at 138th street and Locust avenue, New York City. Plans and specifications for structural steel work, mason work, roofing, etc., may be obtained from the Production Engineering Co.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

Operations are expected to be started shortly in the new plant of the Northern Foundry Co., Laporte, Ind.

The Lufkin Foundry & Machine Co., Lufkin, Tex., has decreased its capital stock from $200,000 to $149,500.

The capital stock of the Sterling Steel Foundry Co., Pittsburgh, has been increased from $293,000 to $313,000.

The National Foundry, Mfg. & Supply Co., Williamsport, Pa., has increased its capital stock from $100,000 to $150,000.

The Eagle Iron & Brass Foundry, San Diego, Cal., has purchased the foundry of G. W. Simpson, of that city.

The Norfolk Structural Co., Norfolk, Va., has added to its facilities the plant of the Berkley Foundry & Structural Co., Inc., which it recently purchased.

The Shepard Plating Co., Racine, Wis., has been organized with a capital of $5,000 by William H. Shepard and Peter Ruetz.

The east and south wings of the foundry operated by the Althouse-Wheeler Co., Waupun, Wis., were badly damaged recently by fire.

The plant of the Hanks Foundry Co., Rome, Ga., has been removed to new quarters in West Rome, where the capacity is increased largely.

The Sparta Foundry Co., Sparta, Mich., has been incorporated with $5,000 capital, by G. E. Rose and W. J. Van Gorden, to operate a foundry.

The Enterprise Iron & Foundry Co., Fort Worth, Tex., has been incorporated with a capital of $15,000, and plans to build a foundry. W. H. Horrell is interested.

The Minnesota Radiator Co., Duluth, has commenced operations. The foundry is 50 x 140 feet and several smaller buildings house the office and lesser departments.

The McCarte Foundry Co. has been incorporated at Brooklyn, N. Y., with a capital of $10,000 by Alex McCarte, S. W. McCarte and S. H. Sarahan, 288 North Broadway, Yonkers, N. Y.

The Atlas Foundry Co., Cleveland, has been incorporated with a capital stock of $10,000 to operate an iron and steel foundry. The incorporators are B. R. Pearse, A. Wathey, D. E. Werts and C. W. Johnson.

Holmes, Pyott & Co., Chicago, has been incorporated with a capital stock of $200,000 to conduct an iron foundry, structural iron works, etc. The incorporators are Oliver W. Holmes, David A. Pyott and Walter E. Pond.

The Racine Pattern Works, Racine, Wis., has been incorporated with $10,000 capital,

by Wenzel J. Simanek, J. C. Hamata and W. H. Armstrong. A pattern shop was established some months ago by Messrs. Simanek and Hamata.

The consolidation of the Coeur d'Alene Hardware Co. and the Coeur d'Alene Iron Works, Wallace, Idaho, is preceded by the incorporation of the Coeur d'Alene Hardware & Foundry Co. with a capital of $500,000. The incorporators are Eugene R. Day, James F. McCarthy and Ellis L. Hale.

The National Steel Foundries has been organized by the National Brake & Electric Co., Milwaukee, to take care of the latter's sales of steel foundry products. The general office will be in Milwaukee and sales office at 811 Railway Exchange building, Chicago. An addition to the steel foundry is being completed, doubling its output.

F. Ferguson & Son, iron founders, Clinton and Twelfth streets, Hoboken, N. J., will install a magnet and traveling crane over their storage yards, the former not having been bought. A new pattern storage has been provided and the new storage capacity for coke and iron will be increased. The concern is rebuilding after a fire.

The firm name of Boyd & Johnson, operating the Genesee Foundry at Genesee, N. Y., has been changed to the Genesee Plow Co. and the following officers have been elected: F. Boyd, president; F. Johnson, vice president, and C. H. Webb, secretary and treasurer. A 50-foot addition is to be erected to this shop which is equipped for the manufacture of iron and brass castings.

The entire plant of the Dean Mfg. Co., Newport, Ky., was sold at auction on Dec. 17, by order of the court. The sale included the plant, machine tools, foundry equipment, motors and engines, which were disposed of in separate lots, there being in all about 100 purchasers. The Dean Mfg. Co. manufactured the Fox marine motor, the Dean gas and gasoline engine and also operated a gray iron foundry.

The Bowler Foundry Co., Cleveland, has completed an addition, 58 x 210 feet, which increases its capacity 50 per cent. The building is of steel construction. Among the equipment installed are two 15-ton cranes furnished by the Cleveland Crane & Engineering Co., one 300-horsepower Bruce-Macbeth gas engine, three Osborn Mfg. Co. molding machines, one Ingersoll-Rand compressor and a 36-inch Sly sand blast mill.

The Lehigh Valley Foundries & Mfg. Co., Easton, Pa., announces that in order to meet the demands of business the Gallagher Carburetor Co., Inc., 1876 Broadway, New York City, has purchased the Edwards & Smith Co. foundries at Easton to operate under the name of the Lehigh Valley Foundries & Mfg. Co. The output will consist of carburetors, strainers, shock absorbers, special valves and brass and aluminum castings of all kinds.

The Hale Garment Machinery Co., Cincinnati, which specializes in garment pressing machines, employs cast brass, cast gray iron, cast aluminum, cold rolled steel bars, machine bolts, band iron, brass pipe fittings, seamless brass tubing and perforated plates in the manufacture of these machines. The company desires to get into communication with manufacturers who can turn out perforated plates 1/16 inch thick, 30 x 10½ x 7½ inches.

New Construction

Robinson & Co., Richmond, Ind., are planning to enlarge their foundry.

J. W. Conway, Hartford, Conn., is erecting an addition, 44 x 46 feet, to his foundry.

Plans have been completed for the erection of a plant for the Bay View Foundry Co., Sandusky, O.

Adam Danner, Bronx river road, Yonkers, N. Y., will erect a brick foundry and machine shop, 53 x 54 feet.

Additions and improvements will be made to the plant of the Lynchburg Foundry Co., Lynchburg, Va., in the spring.

An addition, costing $25,000, to the plant of the Hope Foundry Co., Warren, R. I., is expected to be ready for operation in March.

An extension is being built to the plant of the Charleroi Foundry & Machine Co., Charleroi, Pa. A runway for a 10-ton crane, which will serve the main building, will be installed.

The Northern Foundry Co., Sault Ste. Marie, Mich., has had plans prepared for the construction of a machine shop in connection with its foundry, to cost approximately $13,000.

The Otis Elevator Co., Buffalo, is erecting a 120 x 432-foot foundry estimated to cost about $200,000. The building will be of brick and steel construction. An electric furnace will be installed with a daily capacity of 12 tons.

The Raul Co., Patton building, Milwaukee, was awarded the contract for building a malleable iron works for the Midland Malleable Iron Co., Midland, Ont., recently organized by E. J. Vanderboom. The investment will be over $100,000 and will include a brick and concrete foundry, 83 x 503 feet, which is to be completed by June 1.

Among the Brass Founders

The Coe Brass Co., Torrington, Conn., contemplates the erection of a new casting shop. The new foundry will be 350 x 500 feet.

The Hope Foundry Co., Cranston, R. I., is completing the erection of a large addition to its foundry.

The Canadian Bronze Co., Ltd., Montreal, has been incorporated with a capital of $2,000,000.

An addition, 100 feet square, will be made to the plant of the Bristol Brass Co., Forestville, Conn.

The Dietz-Roemer Brass Co., Baltimore, Md., will erect a brass foundry, 25 x 75 feet, four stories high.

The Cassady-Fairbank Mfg. Co., Chicago, has purchased the plant of the East Side Foundry Co., South Chicago, Ill.

The Ansonia, Conn., branch of the American Brass Co. will erect an addition to its plant, 60 x 440 feet.

The Victor Brass Co., Cleveland, has commenced the erection of an addition to its plant, 30 x 60 feet.

The foundry of the United States Brass & Iron Foundry Co., Flint, Mich., was damaged by fire with a loss of $10,000.

A. H. Anderson, 1215 Fulton street, Chicago, is adding a brass foundry to his plant. The building will be two stories, 25 x 125 feet.

The Kitson Co., Philadelphia, manufacturer of plumbers' brass goods, has removed to its new plant at Twenty-eighth street and Gray's Ferry avenue.

The Eureka Brass Mfg. Co., St. Louis, has purchased a tract of land near the Terminal railroad in North St. Louis, on which it contemplates the erection of a large brass foundry. The company makes a specialty of railroad work.

The Waynesboro Metal & Foundry Co., Waynesboro, Pa., is erecting an addition to its plant and a furnace will be installed for smelting drosses.

The Willour Mfg. Co., Ashland, O., recently incorporated with a capital of $30,000, will engage in the manufacture of plumbers' brass and a brass foundry will be erected.

The New Brass Works, Detroit, has been incorporated with $4,000 capital to manufacture brass specialties. The incorporators are John B. Schmandt, Hugh T. McClune and Henry Levitt. A foundry for the manufacture of brass castings will be erected.

The Payne Die Casting Co., Indianapolis, recently incorporated, will manufacture Parsons manganese bronze die castings by a new process. Heretofore die casting has been limited almost entirely to the softer metals.

The St. Thomas Bronze Co., Ltd., St. Thomas, Ont., has been organized with $2,000 capital to engage in the manufacture of brass and bronze castings. Maurice Alexander and Colville Sinclair, of Montreal, are among the incorporators.

The Northwestern Brass Co., Ltd., Winnipeg, Man., has been incorporated with $1,000,000 capital to engage in the manufacture of brass and bronze castings. The incorporators are G. C. Jones and P. R. Diamond, of Montreal.

The Chappell Brass Foundry, 281 Dyer street, Providence, R. I., has been equipped for the manufacture of brass, bronze and aluminum castings. Leon Chappell formerly was foreman of the brass foundry of the General Fire Extinguisher Co., Providence, R. I.

The Continental Brass & Foundry Co., St. Louis, has been incorporated for $25,000 to manufacture and deal in brass and other metal goods. The incorporators are Ferdinand Messmer and F. Ostrander, St. Louis; J. D. Klemme, Belleville, Ill., and Joseph Messmer, Kirkwood, Mo.

The Byesville Foundry & Machine Co. has been organized at Byesville, O., to engage in the manufacture of iron and brass castings. The officers of the new company are T. W. Scott, president; C. C. Cosgrove, secretary; A. J. True, treasurer, and Karl M. Garner, manager.

The Paragon Brass Mfg. Co., Cleveland, has been incorporated with $100,000 capital and will take over the business of the Sanitary Co., manufacturer of plumbers' brass goods. The officers of the company follow: President, H. H. Hackman; secretary, H. J. Geurinck, and treasurer, R. C. Koblitz.

The American Die Casting Co. has established a plant at 375 Kent avenue, Brooklyn. Die castings of various kinds and from various alloys are made to meet the requirements of the trade. The officers of the company follow: President, E. Mayer; vice president, J. Schultz, and treasurer, J. Kradlaw.

The new plant of the Michaels Foundry Co. will be located on Scott street, Covington, Ky., the site costing $16,500. The property includes a four-story office building and a one-story warehouse. The latter will be used for the brass foundry and the office building will be converted for manufacturing purposes.

Foster Merriam & Co., Meriden, Conn., manufacturers of cabinet hardware, brass and gray iron castings, will erect an addition to their foundry, 50 x 120 feet. This addition will be equipped with an overhead trolley system and two cupolas will be installed. In addition to the foundry, the company operates a metal working plant and plating room.